Discourse, Design and Pedagogy in Translational Medicine

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Abstract

This dissertation is an ethnographic exploration into how translation is defined, taught and practiced in translational medicine. Based on fieldwork at translational research centres–one in Saint John and one in San Francisco–I confront a central tension between ways of understanding what translation is and how it should be performed in biomedicine. For some, translational medicine is simply another approach to commercializing research. For others, it is a novel way to bring researchers, governments, private companies and local communities together to shape a more democratic biomedical future. I argue that the latter perspective suffers from a lack of deep appreciation for the cultural, political and ethical complexities of translation. This is problematic because translational medicine implies the coming together of multiple languages, disciplines, bodies, technologies and institutions, and suggests a greater sensitivity to the unique and ever-shifting experiences of patients and their loved ones.

Addressing these concerns, I put translational medicine in conversation with a variety of STS theories, and those from other disciplines that have long debated the messiness of translation. Experimenting with a deliberative approach to STS, I used participant observation, semi-structured interviews and online ethnography to actively debate what's at stake in a translational approach to biomedicine. My unique role as STS scholar allowed me to challenge frameworks proposed for the near and distant future of translational medicine. Rather than an antagonistic posture, I worked, though often failed, to develop what Sarah Franklin (2013) calls "interliteracies," or the "disciplined reading across disciplines" with my interlocutors. These interventions culminated with me combining STS and translational medicine in the design of a role-playing exercise for high school students at Princeton University. This exercise imagined a future where non-expert publics were more fully involved in determining what pieces of research can and should be translated.

This dissertation contributes to increased calls for engaged approaches to STS that challenge and make decisions about how technoscience is practiced. By showing that translation is a shifting, non-linear and always unfinished process, this project opens space for STS to not simply say "it could be otherwise," but actively be a part of *making* it otherwise.

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I took a winding, unconventional path to finally completing this dissertation. So many eyes and ears have granted me their attention, insight, patience and unconditional support throughout this journey. I'll never be able to thank everyone who touched this work, but I'll try my best.

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What else can I say? I'm a wildly lucky man!

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Many complain that the words of the wise are untranslatable. When the sage says "translate," a dictionary would be of no use. All talk of translation only emphasizes the impossibility of what we already know to be impossible. Our daily struggles with words and meanings are of a different kind.

On this subject, someone said: "Recognize yourself as a translation, and you will be able to translate anything."

Another said: "I bet that is also a translation."

The first said: "You win."

The Second said: "But only in translation."

The first said: "No, in reality. In translation, we have other words for it."

- From ***Franzlations: The Imaginary Kafka Parables*** by Gary Barwin, Craig Conley and Hugh Thomas (2011).

prologue

Questions of translation bedog this dissertation. This is nothing shocking for a piece of graduate research in science and technology studies (STS), sometimes called a "sociology of translation" (Baiocchi, Graizbord and Rodríguez-Muñiz 2013; Best and Walters 2013; Callon 1984; Latour 1979, 1987, 1993, 1996, 2005; Law 1992; Law & Lin 2020; Mol 2002). STS scholars have long traced complex paths through which disparate interests, bodies, expert domains, languages and technologies are stabilized (literally and figuratively *translated*) into successful knowledge practices, fields of research and innovations (Dumit 2004; Helmreich 1998; Latour 1996; Latour and Woolgar 1979; Law 2002; Mol 2002; Thompson 2005; Traweek 1988, 2005). Yet, there is a unique dilemma in the following pages. This is because related concerns around translation shaped, or were at least deeply implied by, the work of my interlocutors in what is known as *translational medicine*. Rather than a distinct field of biomedical expertise, translational medicine is an ambiguous and amorphous name given to a range of strategies for the expedient transformation of basic research into novel technologies, drugs, clinical practices, and treatment protocols (Duffy 2020; Fort et al. 2017; Geraghty 1993). The *Coles Notes* version of what has motivated the emergence of translational medicine in the past three decades doesn't sound much different than the preoccupations of STS scholars, especially those obsessed with the rendering and dissemination of novel facts and technologies (Bijker, Hughes and Pinch 1987; Knorr-Cetina 1999; Latour 1996; Myers 2015). They are two sides of the same asymmetrically shaped coin. On one side, STS scholars study and trace the complex interactions that bring people, technologies and institutions together to generate facts and innovations. On the other side, practitioners of translational medicine want to bring researchers, private companies, government funding bodies and the general public more closely together to more quickly and meaningfully convert new knowledge into better practices, diagnostics and treatments. As a result, proponents of translational medicine increasingly share with STS scholars deep concerns with the multiple expert domains, languages, devices (both digital and analog), political economic maneuverings and cultural specificities that expand and constrain biomedical innovation (Hostiuc 2016; Mittra and Milne 2013; Robinson 2017).

So, translation itself ends up serving as a tricky throughline in this doctoral project, connecting my training, methods and theories to the everyday discourses, designs and pedagogies of those I decided to focus my attention on. As a result, I turn the same deceptively simple questions about translation onto myself and my interlocutors: What is it? How, where and when is it practiced? What are its politics and moralities? How does it both transmit and conceal meaning? More importantly, what gets translated, by whom, and for what purposes? Who and what does translation betray and leave out? When, if ever, can we say something has been successfully translated?

There are some fundamentally important aspects of translation—which I define as a *necessary, though impossible to perfect, human process*—that are either left uninterrogated or taken for granted by STS scholars (Best and Walters 2013; Criado 2017) *and* proponents of a translational approach to biomedicine. This is particularly true of those for whom translation serves as little more than a helpful metaphor (Greenhalgh and Wieringa 2011; Marková 2018). Yet, why do we assume that translation is being used metaphorically, either in translational medicine or STS? Translation can only be a metaphor in these contexts if people assume that translation is exclusively concerned with words, either written or spoken. But translation is and always has been about so much more than words, which is precisely what makes it such a fascinating hook for both STS and translational biomedicine, which for me represent two distinct but overlapping threads of late 20th and early 21st century entrepreneurial technoscience.

As a result, I want to start from the assumption that both STS and translational medicine are concerned with *actual* translation. Of course, these are not literal translations but dynamic ones (Nida 1969). In both domains, languages, bodies, devices, codes, money, politics and culture (to name a few categories) are translated across and between multiple sites and stakeholders. As a result, there can never be a perfect one-to-one equivalence between, for instance, a piece of basic research and the technoscientific innovations it helps inspire. The work certainly requires metaphor, interpretation, creative liberties and unique sensitivity to cultural context, but that doesn’t mean translation itself is a metaphor in STS or translational medicine. In fact, these multi-mediated and multi-modal qualities are fully in scope with a richer and more dynamic understanding of translation that has existed for centuries (Halverson 1999). So, in this dissertation, I’ve chosen to sit with and play with this broader understanding of translation across, between and beyond STS and translational medicine. I do so at three major field sites, which include translational research centres in San Francisco and Saint John, and one high school STS class which was part of an academic summer camp at Princeton University.

My approach to this work takes calls for modesty-driven situatedness, especially from feminist, queer and postcolonial STS scholars, very seriously (Argyriou 2021; Cipolla, Gupta and Rudin 2017; Haraway 1991, 1997; Harding 2011; Wajcman 2000). In the last few decades, both STS (Law and Lin 2017; Tsukahara 2009) and translational medicine (Alving et al. 2013; Shahzad et al. 2011; Rajan, forthcoming) have gone global, and I make no claims either to an exhaustive critique of the methods and theories of the former nor a wholly representative ethnographic encounter with the latter. I simply want, among other things, to be mindful of the possible pitfalls of unreflexive naming practices. Choosing translation over other possible designations means something, regardless of whether individual practitioners are compelled to interrogate it as a name, concept and set of practices. By engaging in serious play (Rieber, Smith and Noah 1998; Statler, Heracleous and Jacobs 2011) with translation, I offer something to both STS and translational medicine. As a contribution to STS scholarship, I see this dissertation as an invitation for reappraisal and reinvigoration of a central theoretical device. Perhaps kernels of ideas here can present new pathways for understanding how translation, as an inherently messy, political, multi-mediated and cross-cultural process, can help us not just study, but generate more meaningful interventions into the politics and practices of technoscientific innovation. As a critical analysis of translational medicine, I use my major field sites in Saint John, San Francisco and Princeton to highlight how translational medicine, as a name, category and set of practices can sometimes be misappropriated, misused and *mispronounced* in shaping the contours of possible biomedical futures. This is especially true when it comes to how some frameworks for translational medicine suggest they want to include non-expert citizens in making decisions about what research can and should be translated, but fail to follow through on bringing these stakeholders to the table. This latter point does not presume an essentialist notion of what translation is or could be in biomedicine, but it does remind us of the importance of *care* in naming practices.

As is always the case with anthropologically-informed STS, the above points can best be digested by way of an anecdote from the field.

What's In A Name?

On the morning of June 8th, 2017, I received an email from Dr. Keith Brunt, head of Dalhousie Medical School New Brunswick's (DMNB) Brunt Research Lab. It was with Keith, along with his students and colleagues in business and academia, that I began the second leg of my fieldwork in the summer of 2013. The email's subject simply read, "thought you'd find this interesting" and the body contained nothing but a link to a recent article by CBC New Brunswick's Jacques Poitras. The story was about the Wolastoqiyik Grand Council advocating for the St. John River to return to its original Indigenous name. For centuries the Wolastoqiyik–often rendered *Maliseet* in English, a Mi'kmaq word meaning "broken talkers" (Schneider and Perley 2012) and referencing the Mi'kmaq belief that the Wolastoqiyik spoke a "broken" version of *their* language (Chamberlain and Ganong 1899: 8)–had lived along the banks of this river. Their name for it, commonly spelled *W-o-l-a-s-t-o-q*, roughly translates into English as "the good, beautiful and bountiful river" (Perley 2007). Wolastoqiyik itself means "people of the river" (Perley and O'Donnell 2005), emphasizing the ever-flowing body of water's role in their embodied, social and spiritual identities.

Samuel de Champlain provided the colonial pseudonym, "Fleuve Saint-Jean" or "la Rivière St-Jean" in French, during his first visit, as part of Pierre Du Gua de Monts' expeditionary entourage, to the mouth of the river on June 24, 1604 (Rudin 2004). The choice of name was coincidental, as the expedition arrived on John the Baptist's feast day (Rudin 2004; Marquis 2004). Though Basque, Breton and Norman fishing expeditions in the 16th century preceded de Monts and Champlain’s encounters with the river and the Wolastoqiyik people (Cahill and Ouellet 2015; Raymond 1910; Turgeon 1998), these French colonists had the strategic wherewithal to “name” and “discover” the river (Rudin 2004). The region became a small but materially and economically critical piece of a massive jurisdiction, Acadia, over which Henry IV had claimed control (Fiske 2002; Jones and Ells 2009).

The idea of returning the river to its original name came from a Wolastoqiyik youth. Debates became somewhat heated between community leaders, local historians and scholars. At issue was whether there should be a unified spelling and pronunciation of the name, a way to avoid confusion with non-Wolastoqiyik, particularly English speakers. Andrea Bear Nicholas, former chair in Native Studies at St. Thomas University, told Poitras that “[i]t's fine enough to go back to an original name, but if no one can pronounce it correctly, we're going two steps backward” (Poitras 2017, para 7). For Bear Nicholas, the correct spelling would be *W-ə-l-ə-s-t-ə-q*, following the phonetic alphabet. “Ə” in this case would represent the “uh” sound. As she put it, this should “not be a strange sound to English speakers, whereas 'Wolastoq' has been pronounced by non-speakers as 'wall-ostock' and that is so grating to the ears of speakers of our language, and so counter to the intention of this project of returning to our original name” (Poitras 2017, para 6). Bear Nicholas’ choice of spelling and pronunciation was informed by a writing system developed by linguist Karl Teeter, a fact not lost on Grand Chief Ron Tremblay. For Tremblay, the spelling and pronunciation debate was arbitrary because “[w]e never had a writing system. They're just linguists, and colonial writing systems. That's why it's kind of irrelevant to try to choose one over the other” (Poitras 2017b, para 16).

As part of a larger project to reinvigorate Wolastoqiyik language and customs, these debates highlight how names traverse messy histories and geographies of power, knowledge, identity and influence (Schneider and Perley 2012). Returning the river to its original name would be a modest but powerful renunciation of the ever-present pains and inequities of colonization in the Canadian Maritimes. Bear Nicholas emphasized that this *re*-renaming “would be part of announcing our presence, that we're still here, and that somebody took it upon themselves to change these names as a kind of colonial act of claiming territory that didn't belong to them” (Poitras 2017, para 13).

On June 12, 2017 the New Brunswick government rejected the proposal to return the river to its original name. Officials cited the river’s “international status” as it crosses borders between Maine, Quebec and New Brunswick (Poitras 2017b). This would require the cumbersome task of building multiscalar alignment between the governments of Canada, Quebec, New Brunswick, the United States and Maine. Grand Chief Tremblay and others were quick to point out that the river and its Wolastoqiyik name long predated borders born out of colonization. They pointed further to alignment with the United Nations Declaration on the Rights of Indigenous Peoples, including their right “to designate and retain their own names for communities, places and persons” (Poitras 2017b, para 17). As of this writing, the issue remains unresolved, a reminder of ever-shifting challenges and opportunities that stem from wading in the messy middle of the material and political consequences of names and categories.

It came as no surprise that Keith assumed my interest in this story. The DMNB was established on the University of New Brunswick’s Saint John (UNBSJ) campus, located north of the city’s uptown core and mere metres from the intersection of the rivers Kennebacasis/Kenepekachiachk, Saint-Laurent/St. Lawrence and

Wolastoq/Wəlastəq/Saint-Jean/St. John. It was here that I met a group of Keith's colleagues, researchers negotiating concerns regarding the use and misuse of Indigenous healing treatments and practices in fighting the global Tuberculosis (TB) crisis. It strikes me that debates around the river's name and debates around how best to bring together Western and traditional Indigenous healing practices in the treatment of TB echo one another. Both are reflections of the complex ways in which colonialism's wake leaves much to be claimed and reclaimed when it comes to names, places, categories and practices (Brattland and Nilsen 2011; Battiste 2011; Rose-Redwood 2016; Wojtuszewska 2019).

Dr. Duncan Webster, an infectious disease specialist, and Dr. Chris Gray, a natural products chemist and ethnopharmacologist, were working with an Eskasoni community in Cape Breton to develop targeted treatments based on a cow parsnip tea used as a general tonic for respiratory health. Duncan and Chris, two self-identifying researchers in translational medicine, were building what the CIHR's Institute for Indigenous People's Health (IIPH) described as a "two-eyed seeing" (Hall et al. 2015; Peltier 2018; Smylie et al. 2004) model of collaboration. The goal is to keep one eye on the benefits of Western technoscience and the other on the rich holistic philosophies and practices of Indigenous healing. Duncan and Chris were struggling not just with integrating two distinct ways of knowing but two vastly different motivations for gathering and sharing knowledge in the first place. These researchers were just beginning to come to terms with the impossibility of *reconciling* their desire for a targeted drug with a richer appreciation of holistic spiritual processes by which cow parsnip heals. Duncan and Chris were also learning that they could never undo violent histories of colonization. Still, they felt compelled to commit themselves to forging new partnerships with traditional healing practices and practitioners. For Duncan, this was part of a larger goal to recognize that there is no separating health from culture. As he put it:

> Health and culture are intertwined. The solution is not for white doctors to come in and say "look, this is what you need." The approach is, let's revitalize communities from within. I see looking at traditional medicines as a chance to take part in that. I wanna say, "look, you guys have used this for generations. It's not lost knowledge, but a lot of people don't know about it. I used to make the mistake of saying that I was 'validating' traditional knowledge in the lab. That's obviously the wrong way to frame it…it is just another way of knowing (from Field Notes, October 2013).

These two contexts, a debate around the origins, spelling and pronunciation of a river's name and the political, cultural, ethical and economic pitfalls of two-eyed translational research are a fitting set up for *Discourse, Design and Pedagogy in Translational Medicine*. These are rich overlapping reminders of Eastern Canada's long-standing status as a flashpoint for violent imbalances of power and knowledge shaped by and shaping cross-cultural movements of language, bodies, ideas, money and institutions. Always at stake is how, by whom and for what purposes multiple translations can or should be pursued. At stake is who gets to negotiate the terms, dominant narratives and ultimately reap the rewards of uneven cultural encounters.

This dissertation attends to similar concerns around another name and category that moves troublingly across and between multiple scales, histories, languages, geographies, expert domains and media channels in contemporary biomedicine: *Translational Medicine*. Translational medicine–and its conceptual cousins, translational science, translational research and knowledge translation–has fascinated me for more than a decade. My initial curiosity was driven by a concern that the *idea* (Davies 2012) of translational medicine was directing flows of capital, research, as well as flesh and blood bodies, but its underlying motivations and material consequences were unclear. For Gail Davies, translational medicine works just as well as an idea, concept or set of potentialities as it does a concrete field of research or program for research funding. It is consequential regardless of whether everybody has sincerely bought into it as a measurable set of practices and outcomes. As a result, it is worth doing a deeper dive into the words and phrases people use to describe and promote translational medicine in specific settings. There is a cultural specificity to how translational medicine is deployed in different biomedical contexts. This makes it impossible to make generalizable or representative claims about what it is and how it works. But that specificity opens rich insights both into the inner-workings of individual research settings and the ways in which my own theories and practices of translation, from STS and other fields, can be deployed to analyse and intervene.

Translational Waterways

The Wolastoq/Wəlastəq river in Saint John and Mission Bay in San Francisco served as major research settings for this work. Each presents a unique example of the choppy pasts, presents and futures of capital-intensive technoscience. Saint John and Mission Bay are former 18th and 19th century shipbuilding hubs turned troubling “trading zones” (Galison 1997, 2010; Jensen 2020) between chronically ill and economically struggling residents and teams of global biomedical experts brought in to save lives and shape new bioeconomies. In Saint John, researchers at the DMNB and Brunt Lab were just as interested in overcoming local healthcare crises as they were in reimagining the “value proposition” the city could offer New Brunswick, Canada and, in meeting Keith’s large-scale ambitions, the world. There is desperation, on the part of local politicians, business leaders, researchers, artists and the general public to rebuild a city that's last moment of political and economic cache was more than a century ago and whose population is suffering from heart disease (Gupta et al. 2013), diabetes (Government of New Brunswick 2016), low employment and few prospects for the future (Marquis 2017). The emerging biomedical culture in Saint John is as much a sales pitch for improving the city's economic health and marketability as it is a reflection of the individual needs of unhealthy local residents.

Unsurprisingly, the people defining the terms and practices of translational medicine in Saint John are researchers, business leaders and politicians. Patients and their loved ones are much discussed, the implied beneficiaries of an array of biomedical translations, but their embodied needs and experiences rarely shape decisions about how, when and where translation is to be practiced (Burke et al. 2018; Sampath, Guler and Smith 2021). Even in the collaboration between Duncan, Chris and the Eskasoni community, there is a clear delineation between relevant experts (in both traditional healing and Western technoscientific domains) and their non-expert beneficiaries. Many assume that translation in this context is an inherently unidirectional process (Etzkowitz 2006; Van der Laan and Boenink 2015) by and through which experts improve the lives of unhealthy non-experts. It is these experts who get to discover, name and direct flows of money, knowledge and institutional influence.

The story at UCSF Mission Bay is both remarkably similar and vastly distinct. San Francisco is obviously a far more established hub of biomedical and biotechnological innovation than Saint John. It is also much further along in dealing with the impossible to fully reconcile imbalance between massive amounts of money and infrastructure flowing in and out of Silicon Valley and the increasing number of homeless, impoverished and chronically ill residents. Still, the story is much the same as Saint John, with an emerging translational medicine culture that speaks so often, and often so passionately, about the need to not only support but actively empower local communities to play key roles in deciding what research should be supported. Yet, again, talk of community refers mostly to political, medical and business leaders, not the people suffering from the consequences of colonialism's most recent social, economic and technological mutations.

As sites of translational medicine, Saint John's DMNB and UCSF's Mission Bay campus provide interesting case studies into how translation is understood in some corners of translational medicine. In these settings, "translation" is often nothing more than a new, and less gauche, way to say "commercialization," which has immediate consequences for the bodies, minds and spirits deemed relevant enough to play decision-making roles in determining what research should be translated in the first place.

So, more than anything else, my field sites represent specific examples of translational medicine that fail to take seriously the violent cultural histories and politically charged realities of translation itself. This is precisely where my training in STS becomes both an advantage and a frustrating challenge. Despite my criticisms of the way translation has been deployed in many areas of STS scholarship, the fact that the field has a long history of engaging the concept at all is a useful foundation on which to offer some insights around how it might be more meaningfully picked up in translational medicine. The same is true in the other direction, as the very existence of translational medicine suggests that biomedical innovators are as and, perhaps in some cases, more aware of the complex networks and entanglements that make their work so challenging. What can STS scholars, especially actor-network theory and its variants, glean from an amorphous area of biomedical labour that takes for granted what is often the big reveal in our case studies?

At least in the context of DMNB and UCSF, the dominant discourses and models of translational medicine did not recognize translation as, first and foremost, an inherently imperfect cultural activity embedded in uneven dynamics of power and knowledge (Foucault 1980, Rabinow 1991).[1] Duncan and Chris are very much the exception rather than the rule. Countless examples of attempts to communicate the goals and ambitions of translational medicine get wrapped up in dated understandings of technoscientific progress. These are informed by long debunked deficit models of scientific literacy (Drummond and Fischhoff 2017; Nadkarni et al. 2019; Requarth 2017) and linear models of progress and innovation (Etzkowitz 2006; Godin 2008, 2017; Joly 2017). These models do very little to address the diverse concerns of publics that are not only the proposed target audience/market for biomedical translations but also fully embedded in their own complex encounters with anxious bio-futurities (Barash 2016; Lehoux et al. 2009; Sandino 2018). As anthropologist William Lampert puts it, "[c]ommunities are empowered and constrained by the constellation of their members' expectations, fears, and hopes for the future" (2014, 173). Indeed, who gets to spell, pronounce and define what biomedical translation is? How, by whom, and for what purposes can or should it be practiced and what future(s) may it foster?

Re-reading the CBC article Keith sent me, it strikes me that there is another layer of accidental meaning attached to the debate over rivers, names and who gets to own the

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[1] Scattered throughout his writings and lectures, Foucault highlights the ways in which power and knowledge are intimately entangled with one another. Power, he argues, is only possible through accepted forms of knowledge and truth, which are themselves the unique consequences of a number of social and cultural factors (1980).

dominant narratives of cross-cultural encounters. In studies of language and literature, translation is often described as the crossing of a body of land or water, especially rivers (Guldin 2012). As Rainer Guldin points out, this is best exemplified in the German word "übersetzen," used "in the double sense of *über*setzen, setting across a stream or river, and über*setzen*, to translate" (2012: 3). Guldin has called for a deeper engagement with the relationship between discourses of geography and translation studies, especially in the case of water metaphors. As he puts it, "if translating means crossing a river, then the two banks represent the two different languages and the river flowing in between the obstacles to be overcome" (Guldin 2012, 4). For Guldin, this is a decidedly lazy version of events. He champions metaphors of seas, oceans and straits that are less about divisions between ways of knowing the world. As he puts it, we need discourses that emphasize the "porosity of language-borders and the very difficulties of translation, highlighting the absence of any easy binary division" (2012, 1).

There can be no clear boundaries between diverse fields focused on the messy politics of translation in media studies, anthropology, STS, philosophy and translational biomedicine. This dissertation, more than anything, is about the porosity of borders and how they might be more meaningfully traversed by discourses, designs and pedagogies in some corners of both translational medicine and STS.

Walking back from my first tour of the new medical school and the Brunt Lab in August of 2013, Keith asked me if I was ready to sit down in his office and hear his "vision" for the near and distant future of DMNB. Before entering the office I was struck by a series of four pieces of paper with writing in different languages taped to the door, just to the right of Keith's name plate. Each piece of paper had "Dr. Keith Brunt" written in the native language of an international colleague working at DMNB. I asked whether this was meant to be symbolic of his work as a translational researcher. He nodded and suggested that it could be a useful narrative device in *my* telling of *his* story.

Figure 1: “Doors of Translation,” from August 2013. Photo by author.

METHODOLOGICAL INTRODUCTION:

a deliberative multi-scalar ethnography

The structure of this dissertation is the result, to borrow from Anna Tsing (2005), of a "patchwork" approach to ethnographic research and writing. I initially set out to develop a multi-sited (Falzon 2016; Hine 2007; Marcus 1995) ethnography of bioinformaticians working in translational medicine, which I had assumed was an emerging field of academic research. It quickly became clear my object of study was more unwieldy. In broad strokes, translational medicine refers to various strategies for the efficient and expedient conversion of basic biological research into novel clinical or bedside practices, diagnostic tools, drugs and other treatment methods (Cohrs et al. 2015; Feldman 2009; Hegyi et al. 2020; Zerhouni 2004). I've come to realize, over the course of my multi-year quest to find meaning in the moniker, that translational medicine is not reducible to a specific research discipline, policy platform, set of practices, network, or even a coherent set of goals for biomedical research (Vignola-Gagné 2014). It is, rather, a fuzzy and ambiguous way of thinking about and engaging public-private partnerships in capital-intensive and future-oriented biomedicine (Fort et al. 2017; van Dongen et al. 2013).[2] What emerged for me was a fascination with the very nebulousness of translational medicine, precisely because it exists somewhere between a field of research and a policy platform; between an appeal to aspirations for universal human health and a shrewd lamentation of obstacles to biomedical commercialization.

To work inside this ambiguity is to refute that there is an origin story to be told about translational medicine. There are only winding, crossing and diverging paths of

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[2] Since the late 1990s and early 2000s, translational medicine has benefited from widespread financial and rhetorical support in countries all over the world (Albani and Prakken 2009; Alving 2013; Ma et al. 2014; Maarman, Chakafana and Sliwa 2020). Each research centre, policy statement and geopolitical context in which translational medicine is promoted has its own idiosyncratic ways of articulating what biomedical translation is, who it should benefit and how it should be practiced (Clay et al. 2019).

discourse, design and pedagogy down which we can traverse. Inspired by Tim Ingold (2007), this dissertation follows the paths of "growth and movement" of translational medicine across multiple sites and scales. As a multi-sited (Boccagni 2020; Hine 2007; Marcus 1995) and multi-scalar (Erdal 2020; Fortun 2016; Xiang 2013) approach to ethnography, this dissertation resists assuming a pre-existing context in which translational medicine is situated, choosing instead to follow traces of its central concept across and between specific locations, practitioners, motivations and fields of investigation.

The Settings

Research for this project unfolded in three geographic locations and one digital field site. The DMNB and UCSF's Mission Bay campus, described in the prologue, were two North American translational research and training centres that provided me unique access. Like the DMNB, UCSF's Mission Bay campus is a relatively new, if much more sprawling, institution located in close proximity to shipping docks that were central to an earlier period of economic dominance in San Francisco. Home to the Clinical and Translational Science Institute (CTSI), UCSF's Mission Bay campus provided a stark scalar contrast to my work in Saint John, with its heavy funding from multinational biotechnology firms, state of the art facilities and already established global reach and influence. UCSF's CTSI also operated the digital field site in which I worked and played, *UCSF 2025*, an interactive and competitive online "card" game designed by the RAND Corporation's Institute for the Future (IFTF).

My final field site was Princeton University, where for two summers I taught as part of the Center for Talented Youth's (CTY) summer program. This program was specifically set up as a summer camp for (the troublingly labeled) “gifted students.”[3] At Princeton, I taught a course on science, technology and public policy, using translational medicine as a foundation on which to explore new models of public deliberation for determining how biomedical research projects can and should be funded. In other words, I worked with students to imagine a new model of public engagement that could drive more equitable approaches to deciding what can be translated, by whom and for what purposes in biomedical research.[4]

Within these physical and digital field sites, I combined participatory observation and semi-structured interviews with students, instructors, business leaders, researchers and administrators. Though my findings point out the need for more meaningful interactions with patients, their loved ones and a range of traditional and non-traditional health and healing practitioners, this work suffers from a lack of direct research in the homes, hospitals, clinics and other environments where people are navigating the social, physical and emotional experiences of comorbid chronic conditions. As a result, this dissertation serves as a foundation on which to more meaningfully engage communities of patients, loved ones and their healthcare providers (HCPs), rather than a robust intervention into these spaces and experiences.[5]

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[3] Worrell et al. (2019) describe gifted students as existing across academic and non-academic fields. The label is a wildly unhelpful way to describe students with a broad range of cognitive, social, emotional and physical needs, challenges and experiences. Often framed as a stage gate concept, “gifted” is too often used as a way of segregating student achievement based on dated models of academic performance, post-secondary admissions *and* perceived behavioral problems.

[4] It is impossible to hide the fact that the bulk of the research and descriptive writing for this project was completed from 2013-2015. Much has changed at DMNB and UCSF Mission Bay in the intervening years, and much has stayed the same. Writing this final draft in the summer and fall of 2021, I’ve stressed over the extent to which I should update my findings and analysis. Instead, I’ve chosen to let this project sit as much as possible in its past.

[5] It is worth noting that the research contained in these pages directly informs my current employment as a design research and strategy consultant. For the last four years I have worked with North American healthcare systems, pediatric hospitals, pharmaceutical companies, local community health and social service organizations, and international device manufacturers. My work has focused on whether and how biomedical innovations shape and get shaped by the lived experiences of patients, families and healthcare providers, particularly in the context of chronic illness. I have been able to utilize the resources of client organizations to advocate for patients, to push for a greater understanding of chronic illness experiences that go well beyond medical diagnosis and therapy. I hope one day to channel this work into a larger research project tracking the benefits, limits and ethical problems generated by an emerging class of design consultants in the healthcare and wellness industries. For now, this work has proven invaluable to reeling in the arguments outlined in the following pages. In some ways, I have spent the last four years working as the kind of translational researcher this dissertation ultimately calls for. This is especially true in my work with the St. James Town Community Corner, SickKids Children’s Hospital and Sidewalk Labs. These experiences will be directly and indirectly peppered

Overall, I see this as a humble contribution to a long line of STS works emphasizing technoscientific findings and institutions “in-the-making” (Latour and Woolgar 1986; Latour 1987; Knorr Cetina 1999; Mol 2002; Suchman 1995, 2000). 2013 represented a critical “in-the-making” moment for both DMNB and UCSF Mission Bay, and I want to preserve as much as possible the hopes, tensions and anxieties that shaped that time in the field.

Deliberative Ethnography

The theoretical foundation on which my research rests brings cultural anthropology, the philosophy of design and media studies together with theories and methods of what can be broadly referred to as “enactment” (Åsberg and Lykke 2010; Law 1992, 2004; Lin 2013; Mol 2002; Suchman 2007) approaches to feminist STS. This combination of methodological and theoretical perspectives has generated what I am calling a *deliberative multi-scalar ethnography*. In describing this project as deliberative I answer Kim Fortun’s call for modes of ethnographic rendering that are “‘appropriate’ to the historical conditions” of late industrialism (Fortun 2012: 449-50). Fortun describes ethnography as a technology, “a crafted means through which things are enabled” (Fortun 2012, 450). As she puts it, “ethnography, like other technologies, can be designed in different ways–to draw out what is, the state of things, or to show what is at odds with extant theory, ethnography as cultural critique” (2012, 450). In particular, Fortun calls for deliberative and creative modes of ethnographic writing that are future-oriented. Ethnographers have done well, she argues, describing and critiquing the contours of existing technoscience. She suggests, however, that what is missing is an

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throughout this dissertation, adding depth and breadth to my long completed fieldwork. All of this points to accidental yet hard won benefits of delaying the completion of my doctoral degree.

approach to ethnography that can bring forth a “future anterior that is not calculable from what we know, a future that surprises. Ethnography thus becomes creative, producing something that didn’t exist before. Something beyond codified expert formulas” (2012, 450). A more creative and deliberative approach to ethnography requires rethinking how research in STS and cultural anthropology is designed. It also requires practicing ethnography as an “experimental system” (Fortun 2012; Rheinberger 1998) that embraces and makes productive, rather than glosses over, difference, inequity and indeterminacy.[6] Rather, emphasis is on recognizing the importance of collaboration and provocation in research, and developing ethnographic renderings that are descriptive and critical but also push beyond description and critique. Following Jacques Derrida (1991), Fortun urges researchers to generate ethnographic renderings that imagine a future that is not merely a continuation of the present.

Deliberation is both a methodological and analytical driver in this dissertation. I simultaneously analyse how deliberation is facilitated in particular sites and instances of translational medicine and also set up my own deliberative spaces and encounters for negotiating imagined futures for the discourses, designs and pedagogies of biomedical research.[7] As you stroll through the three distinct but overlapping sections of this

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[6] Significantly, a deliberative ethnographic posture does not require idealistic notions of community and consensus-building: “The goal is not to give everyone a chance to speak, as a matter of fairness. The model is not the town hall meeting or the talk show. But it is about being open to intervention and foreigners, about hospitality, and solicitude. The goal is to come together—to literally collaborate, performing the labor of difference, to articulate something that could not be said, could not be brought together before” (Fortun 2012, 453).

[7] My initial interest in “staging encounters” emerged out of a collaborative multimedia project I worked on with Alasdair McMillan during the first four years of my doctoral research. In the project, McMillan and I developed the idea of *embodied propositions*. Embodied propositions was the foundation for an inherently deliberative mode of producing collaborative art and scholarship. The concept was an extension of Bruno Latour’s notion of “articulated propositions”, which was itself the result of Latour’s analysis of work by Isabelle Stengers and Vinciane Despret. For Latour, articulated propositions are a matter of bodies “learning to be affected by hitherto unregistrable differences through the mediation of an artificially created set-up” (2004, 209). McMillan and I chose “embodied propositions” because it maintained a concern with the affective qualities of embodiment as well as the uncertainty of propositional truth or falsity, a centuries old philosophical debate that continues to this day. At the same time, “embodied propositions” gently nudges aside the need for coherence and fluency implied by the use of the word “articulated”. This is not to say that I strive for incoherence in my work. Rather, my approach to all of my research efforts has been a matter of generating artificially mediated set-ups that are often founded on a lack of clarity, understanding and coherence.

dissertation, description and critique increasingly give way to more deliberative approaches to engaging my interlocutors, especially with students at Princeton who help bring this work to a close. In the end, this dissertation reflects *my* role in enacting research encounters and in actively and collaboratively making the unique contexts through which this research unfolds.

Enactment STS and Contexts-in-the-Making

In the prologue to his proto-STS book, *Genesis and Development of a Scientific Fact,* Ludwik Fleck lamented the taken for granted “basic” fact of human perception. “We have nearly ceased,” he argued, “to consider this as even knowledge at all and are no longer conscious of our own participation in perception” (1979, xxvii). Fleck likens this to the behaviour of mass groups of people in which individuals are unaware of their own contributions to shaping the collective environment:

> Consider, for instance, a casual visitor to the Stock Exchange, who feels the panic selling in a bear market as only an external force existing in reality. He is completely unaware of his own excitement in the throng and hence does not realize how much he may be contributing to the general state. Long-established facts of everyday life, then, do not lend themselves to epistemological investigation (1979, xxviii).

An enactment approach to STS (Asdal and Moser 2012; Law 1992, 2004; Mol 2002; Lin 2013), of which Fleck is a proto-constructivist (Brorson 2000) forebear, requires that we take seriously our own roles, as researchers and members of diverse publics, in producing the “general state” in which we live and work. Such an approach leaves room for, and often insists upon, the epistemological investigation of mundane daily life.

Enactment STS refers to a variety of approaches to assessing how reality is made, remade and unmade by and within a diverse range of bodies and environments.[8] Combined with a long-standing push for "engaged" approaches to STS (Hackett and Rhoten 2011; Sismondo 2008; Kinchy, Phadke and Smith 2018), it is impossible to ignore how STS scholars fully participate in world-making (Franklin 2017; Haraway 1991, 1992, 2008) practices that generate contexts of knowledge production, dissemination and consumption (Asdal and Moser 2012). Rather than a focus on ontology *or* epistemology, this calls for a consideration of how STS scholars inform the epistemological *and* ontological status of technoscientific cultures we study. As a result, a driving question in this dissertation is: *How can I embrace and trouble my own role(s) in shaping the technoscientific worlds in which I live, work and play?*[9]

Context, like agency, is something "we constantly need to work on and with" (Asdal and Moser 2012: 296). If enactment STS is founded on a practical ontology where reality is constantly being made, remade and unmade, then so too are the "contexts" used to prop up our research. Context ends up being both a "precondition and the product" (Asdal and Moser 2012, 297) of irreductionist STS (Lin 2013).[10]

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[8] Debates concerning whether we were recently in the throes of an "enactment" (Lin 2013) or "ontological" (Woolgar and Lezaun 2013; Lynch 2013) *turn* in STS were unhelpful, but it is true that the last decade has seen increasingly robust thinking around how the realities of technoscientific labour come *to be*. STS scholars have debated whether we are in the midst of an "ontological turn" in our field, one that embraces and makes productive the existence of multiple worlds and worldviews rather than concerns about the multiple ways in which a single world can be represented by diverse knowledge producers (Woolgar and Lezaun 2013, 322). Yet, it is often unclear how this emphasis is more ontological than epistemological. We need to be very careful with this notion of academic *turns*. They imply a turning "into", "towards" and "away," and they imply the privileging of particular ontologies or epistemologies over others. This is absurd. A desire to trace "enactments" in technoscience can not be predicated on a preconceived notion of what exists and what can be known, not to mention *how* particular things come to exist or be known. We lose too much when we, for instance, privilege language over materiality, when we privilege the bounded interior of a laboratory over the sociopolitical and geopolitical contexts in which laboratory scientists produce and disseminate their work. A telling example can be gleaned from the opening paragraph of Karen Barad's "Posthumanist performativity: Toward an understanding of how matter comes to matter": "The linguistic turn, the semiotic turn, the interpretive turn, the cultural turn: it seems that at every turn lately every 'thing'—even materiality—is turned into a matter of language or some other form of cultural representation. The ubiquitous puns on 'matter' do not, alas, mark a rethinking of the key concepts (materiality and signification) and the relationship between them. Rather, it seems to be symptomatic of the extent to which matters of 'fact' (so to speak) have been replaced with matters of signification (no scare quotes here). Language matters. Discourse matters. Culture matters. There is an important sense in which the only thing that does not seem to matter anymore is matter" (2003, 801).

[9] Indeed, STS, including the actor-network variety, has always laid claim to adding a particular "realism to science" (Barad 2003; Latour 2007), a realism founded on the assumption that no one can predetermine what or who constitutes the relevant agents (in the form of living bodies, devices, concepts, environments, etc.) that will contribute to the collective production of reality.

[10] Scholars working within an irreductionist enactment form of STS have generated a rich array of concepts that imply that a sensitivity to enactment means a recognition that there are always moments of perceived stability and coherence. In particular,

Thinking about context in this way allows for more organic jumps between local, regional and global scales. For instance, we cannot pretend that "globalization" is something that exists out there in the world anymore than we can subscribe to deterministic arguments that on-the-ground realities are what they are *because* of globalization. We can, however, show that ways of thinking about "the global" inform and get informed by local and regional networks of citizens, researchers, politicians, animals, plants, concepts, technologies and shared environments (Tsing 2005).[11]

Feminist, queer and post-colonial STS in particular have called for practitioners to take greater responsibility for their own context-making practices. Kristin Asdal and Ingunn Moser call these practices "experiments in contexting":

> This implies that context is something scholars do, rather than something that is pregiven and passively lying out there, waiting to be discovered. This is not to say that context is simply a scholarly construct. The other sensibility we have wanted to cultivate is the openness to the richness of research objects, actors, worlds, and materials. The aim must still be to enrich and not only reduce the worlds that we study (2012, 303).

This dissertation takes seriously my own context-making practices, along with a more dynamic consideration of what counts as relevant to the contexts I collaboratively design, generate and occupy.[12] I navigate and intervene in cross-cultural interactions

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Charis Thompson's notion of "ontological choreography" strikes a chord. In her widely cited study of reproductive technologies, Thompson defines ontological choreography like this: "The term *ontological choreography* refers to the dynamic coordination of the technical, scientific, kinship, gender, emotional, legal, political, and financial aspects of ART clinics. What might appear to be an undifferentiated hybrid mess is actually a deftly balanced coming together of things that are generally considered parts of different ontological orders (part of nature, part of the self, part of society). These elements have to be coordinated in highly stages ways so as to get on with the task at hand: producing parents, children, and everything that is needed for their recognition as such" (2005: 8). Ontological choreography works as a metaphor for staged theatrical performances. Thompson simultaneously highlights the artifice of the moment at which different ontological orders must come together as well as her own artificial rendering practices as an STS scholar. It is not just about the dynamic agencies available to the various "aspects" of ART clinics, but also the dynamic agency possessed by the researcher herself. This, for me, is a crucial consideration, one that I think needs to be made more explicit in a lot of STS research.

[11] Feminist STS has been at the forefront of attempts to generate newer, more flexible and, arguably, better contexts. This includes concerns about the ways in which gender might be written *out* of particular contexts (Haraway 1991, 1997; Keller 1977; Asdal and Moser 2012).

[12] However, I do not want my dissertation to serve as a "guideline" for other people's methodological projects. I do, however, hope that it might be helpful/liberating for those struggling to find themselves in the sometimes needlessly rigid structures of academic methodologies. As Descarte put it in the opening of his *Discourse on Method:* "Thus my purpose here is not to teach the method that everyone ought to follow in order to conduct his reason well, but merely to show how I have tried to conduct my own. Those who take it upon themselves to give precepts must regard themselves as more competent than those to whom they give them; and if they are found wanting in the least detail, they are to blame. But putting forward this essay merely as a story or, if you prefer, a fable in

between biomedical researchers, STS scholars and non-scientist stakeholders. Sarah Franklin and Celia Roberts have suggested that emergent transdisciplinary collaborations in biomedicine generate “interliteracies” that “connect scientists and clinicians to policy-makers, representatives of government to social scientists, and patient groups to journalists in a host of emergent alliances” (2006, xvii). My interest is thus not in seeking interactional or contributory expertise (Collins and Evans 2002, 2007) in translational medicine. Rather, I want to address how ways of understanding translational medicine simultaneously expand and limit capacities for generating meaningful cross-cultural and multi-scalar encounters and negotiations.[13] Which is precisely why this dissertation is as much about an analysis of translational medicine as it is an opportunity to challenge how translation is deployed in my own interdisciplinary field of study and practice.

Enacting Discourse, Design and Pedagogy in Translational Medicine

I explore enactments of translational medicine across three distinct but overlapping parts of this dissertation. The goal is not to trace the origins of translational medicine, or to suppose an existing unity between concurrent discourses, designs and pedagogies of

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which, among some examples one can imitate, one will perhaps also find many others which one will have reason not to follow. I hope that it will useful to some without being harmful to anyone, and that everyone will be grateful to me for my frankness” (1998, 3).

[13] In an episode of CBC Radio’s *Ideas* Harry Collins doubled down on claims that STS scholarship requires a lifelong pursuit of some sort of “expertise of expertise”. These ideas had already been widely dismissed in June 2003’s special issue of *Social Studies of Science*, featuring three critiques of Collins and Robert Evans (2002) desire to generate a “Third Wave” of STS, which they called the study of expertise and experience (SEE). Collins and Evans offered a model of STS that simultaneously over-estimated the moral guardianship of scientists and undervalued the capacity of non-scientist citizens to aid in shaping the contours of risky technoscience in democratic societies (Jasanoff 2003; Rip 2003; Wynne 2003). Arie Rip argued that Collins and Evans failed to consider the coming together of “actors and their interactions” (2003, 428) in their proposed model of expertise. Brian Wynne was frustrated by the idea that Collins and Evans produced a context-free, essentialized understanding of expertise that had nothing to do with the on-the-ground realities of making decisions about technoscientific controversies (2003: 404). Sheila Jasanoff’s comment on Collins and Evans paper accurately pointed out the social, political and cultural contingencies that make claims to expertise possible in the first place. Jasanoff emphasized the importance of institutions in framing and constraining the kinds of research and expertise available to all stakeholders, including scientists and non-scientists. As she puts it, “[e]xpertise relevant to public decisions…responds to specific institutional imperatives that vary within and between nation states” (2003: 393). This suggests that teaching the public how to navigate these institutional imperatives can and should inform how we understand what constitutes a “scientifically literate” citizenry. This last point will drive the core arguments and fieldwork vignettes in Part 3 of this dissertation.

translation in biomedicine. Rather, the goal is to highlight how particular ways of enacting translational medicine shape and get shaped by unique social, historical, political and economic challenges and conditions.

Part 1, “The discursive landscapes of translational medicine,” owes a great deal to critical discourse analysis (CDA), particularly branches emerging in the 1990s and early 2000s inspired by the work of French poststructuralists like Michel Foucault and Roland Barthes.[14] In particular, Part 1 follows what Ruth Wodak and Michael Meyer describe as a “demystification” of power, knowledge and ideology through the “retroductable investigation of semiotic data (written, spoken or visual)” (2008: 3). However, as Barthes put it in *Mythologies*:

> ‘Demystification’–to use a word which is beginning to show signs of wear–is not an Olympian operation. What I mean is that I cannot countenance the traditional belief which postulates a natural dichotomy between the objectivity of the scientist and the subjectivity of the writer, as if the former were endowed with a ‘freedom’ and the latter with a ‘vocation’ equally suitable for spiriting away or sublimating the actual limitations of their situation. What I can claim is to live to the full the contradiction of my time, which may well make sarcasm the condition of truth (1972, 12).

My approach to demystification tracks statements, in the form of words, images, sounds and environments, among others, made by the students, physicians, researchers and policy experts who spent time with me as well as those produced and reproduced in popular and academic media. As a result, my approach to discursive practices and relations is necessarily multi-mediated and multi-modal. Rather than a systematic approach that traces high level “unities” (Foucault 1972) across and between discourses of translational medicine, Part 1 tracks multiple and competing discursive contexts-in-the-making. My interest in enactment STS distinguishes my approach to

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[14] Though there are debates surrounding the extent to which CDA is a distinct field from Foucauldian discourse analysis (FDA), the wide diversity of approaches to each justifies my using them interchangeably under the heading CDA (Johnson & McLean 2020).

CDA from one that seeks to analyze the “opaque as well as transparent structural relationships of dominance, discrimination, power and control as manifested in language” (Wodak 2001, 2). Instead, I analyze the opaque and transparent ways in which translational medicine is enacted in uneven dynamics of power within multiple contexts-in-the-making (Asdal and Moser 2012). This allows me to push beyond description and critique (Fortun 2012), to begin enacting imagined futures of biomedical translation that shape the second and third sections of this dissertation.

Part 2, “Forecasting biomedical futures: design and deliberation in late capitalism,” deepens my engagement with discourses of translational medicine within the context of digital deliberation. I focus my analysis on two forecasting exercises that took place in collaboration with researchers, physicians and administrators at UCSF’s CTSI: 1) a “speed-dating” exercise for imagining new ways of facilitating multidisciplinary biomedical research collaborations; 2) *UCSF 2025*, a virtual “card game” I played in the fall of 2013, for negotiating what biomedical research practices, infrastructures and patient interventions might look like in 2025. My online interactions and participant observations in these exercises is complemented by unstructured interviews and my participation in an in-person team-building conference at UCSF’s CTSI.

Part 2 combines traditional in-person fieldwork and digital ethnography (Boellstorff 2012; Thompson et al. 2021; Varis 2015). As Tom Boellstorff has argued, the digital is not an object of study but a “methodological approach, *founded in participant observation*” (2012, 4, italics in original). In Boellstorff’s framework, digital anthropology does not assume earlier ideas about the separation between the virtual and the physical or more recent ideas about their increasingly blurred boundaries. As he puts it, “this transcendental understanding of the virtual is clearly wrong: the virtual is as profane as the physical, as both are constituted ‘digitally’ in their mutual relationship” (2012, 42). Boellstorff emphasizes the importance of combining elicitation methods with participant observation in digital anthropology. As he puts it, “ethnographers combine elicitation methods (like interviews and focus groups) with participant observation, which, as a method not predicated on elicitation, allows us to study the differences between what people say they do and what they do” (2012, 42). Emphasis for me is on the limitations of a collaborative digital environment for debating and forecasting the future of UCSF’s CTSI, as well as translational medicine and biomedicine more broadly.

The analysis in Part 2 is informed by insights in the philosophy of design, particularly the work of Vilém Flusser and Peter Sloterdijk. Following the work of Sloterdijk (2012), I argue that design is neither static nor politically neutral, but rather a lively practice that can simultaneously expand and constrain possibilities for intimate encounters and collaborations. This way of understanding design informs a more deliberative approach than what is present in Part 1. In these forecasting exercises I identified myself as a Canadian STS scholar interested in the history and anthropology of biomedicine. I offered my own proposals for the future of biomedical research, and critically engaged with and responded to the proposals of others. In challenging these proposals I often suggested increased collaborations between anthropology, STS and translational biomedicine, and actively laid out my personal political and academic preoccupations and ambitions.

My deliberative approach to engaging with translational medicine is made most explicit in Part 3, “Science literacy, citizenship and biomedicine ‘in the trans-’”. This third and final section extends my interest in discourse, design and deliberation by tracing the development of a role-playing exercise, cheekily called "Science Court," for high school and undergraduate students. The goal was to help them understand biomedical peer review processes and consider what translational medicine could look like in different socioeconomic and geopolitical settings. I experimented with new ways we might better prepare aspiring scientists and non-scientists alike to embrace the indeterminacy of biomedical future(s) while also recognizing the need to make timely decisions about funding allocation. In laying this out, I explored the idea that students would benefit from developing what I call *"institutional literacy"* prior to anything resembling scientific, health and media literacies.

Part 3 is informed by a range of self-proclaimed "radical" STS education scholars calling for a brand of science literacy that emphasizes social activism and responsibility (Decuypere 2019; Gorur et al. 2019; Pedretti 1995; Roth and Desautels 2002; Waks 1992) on the part of both scientists and non-scientists. This, I argue, is a useful perspective from which to explore how to better prepare non-experts for making critical decision-making roles in translational medicine.

Multi-Scalar Ethnography

Another methodological and theoretical throughline of this dissertation is an emphasis on the multiple scales across and between which the "dreams and schemes" (Tsing 2005) of translational medicine are enacted. Researchers in a number of fields have attempted to formalize approaches to studying "scalar dynamics" (Appadurai 1990) that inform and trouble understandings of local, regional, national and transnational mobilities and mobilizations of bodies, ideas, money, information and cultural artefacts in the late industrial period. To address these issues, researchers in sociology (Gille and Riain 2002), economics, geography (Romein, Tripp and de Vries 2003), environmental psychology (Qian, Zhu & Liu 2011), language policy (Cabral 2020), urban development (Chowdhury et al. 2011) and anthropology (Juris 2008; Lan 2015; Salverda 2021; Williamson 2015; Xiang 2013;) have developed multi-scalar approaches to research design and practice.

My multi-scalar approach has been most directly inspired by Biao Xiang from Oxford University. Xiang's approach emerged out of questions concerning the basic premise of multi-sited ethnography as defined by George E. Marcus (1995):

> Multi-sited ethnography is now a common method in social anthropology in examining flows and links. Yet, given that movements and connections are infinitely multiple, constantly changing, and always open-ended, how multi-sited is multi-sited enough? (2013, 282).

Multi-sited ethnography invites researchers to follow not just people, but metaphors, stories, things, etc. across a range of sites (Dick and Arnold 2017; Forte 2018; Marcus 1995). A downside, however, is that Marcus's original framework generates research that begins with the assumption that something like a "world system" exists. Xiang's multi-scalar ethnography is not a replacement for multi-sited ethnography, but an additional framework for making it more "practical" and "analytically productive."[15]

Inspired initially by problems related to the study of migration patterns, Xiang has emphasized two ways of understanding scale that might benefit ethnographic labourers: 1) taxonomic scale; 2) emergent scale. Taxonomic scale refers to ways of

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[15] Citing Anna Tsing, Xiang summarizes the goals of multi-scalar ethnography like this: "Multi-scalar ethnography is first of all concerned with how social phenomena, such as transnational migration, are constituted through actions at different scales. Smooth flows at one scale (e.g. international) can be disruptive at another (e.g. family or community). At the same time, smooth transnational flows may not be possible without the deep disruptions in family or the tight encapsulations of individual life. Anna Tsing's (2005) suggestion that frictions between different scales propel the making of global scales is an excellent example of such a multi-scalar perspective. Relations across multiple scales provide us with a vantage point to understand how multi-sited connections actually work, and what the sites mean to each other" (2013: 283).

conceptualizing different levels of bounded space, such as the “regional, local, national and transnational.” Taxonomic scaling allows for the appearance of coherence at these various levels and provides that the:

> superior-subordinate relation in civil organizations is justified without undermining the modern egalitarian ideology: a province governor is superior to a mayor not because the former is smarter or more virtuous than the latter, but because the office of the former covers a broader purview than the latter’s (2013, 284).

Emergent scales are more difficult to trace and define, in part because they do not possess definite:

> ...shapes, are hard to map, let alone to be used as a cartographic tool to map the world (as what physical geographers mean by ‘scale’). What matters is not what a scale looks like but how it is made into reality, what it does for the actors, and the consequences it leads to. Emergent scale is by definition actor-centric and activity-specific (2013, 285).

This is an especially appealing way of conceptualizing scale for someone navigating the murky waters and foggy skies of translational medicine. The concept itself is mobilized in actor-centric and activity-specific ways to capture the needs of local communities (Evans et al. 2019; Kaufman et al. 2017), but the ambitions underlying its discourses and designs often reach for the stars. Research groups imagine themselves addressing local concerns while simultaneously building global biomedical influence (Anderson 2014). At the same time, the increasingly global reach of translational medicine, as a concept, funding framework and set of emerging practices (Shahzad et al. 2011), results in a situation where simply staging research in one site and imagining only the implications of translational medicine within that site would be pointless. It is in the choppy movement between scales that translational medicine, a concept as widely dismissed as it is embraced, gains its discursive, design and pedagogical power.

Ethnographic Puncta

There is one final way through which deliberation, enactment and scale come to life in these pages. Parts 1-3 conclude with case studies framed around my captivation with seemingly insignificant, mundane moments in San Francisco, Saint John and Princeton. These moments of ethnographic minutiae–a stroll through a hospital parking lot, a pithy statement during my participation in *UCSF 2025*, and a serendipitous encounter with a philosophical text while teaching at Princeton–represent what I call, following Roland Barthes (1980), a "punctum" that pushed my research in surprising directions.[16] For Barthes, the punctum is a unique element that unexpectedly draws individual viewers to specific photographic images. As he puts it, "[v]ery often the *punctum* is a 'detail,' *i.e.*, a partial object. Hence to give examples of *punctum* is, in a certain fashion, to *give myself up*" (1980, 43, italics in original). Barthes distinguishes the punctum from the "studium," which represents an "encounter with the photographer's intentions, to enter into harmony with them, to approve or disapprove of them, but always to understand them…for culture (from which the *studium* derives) is a contract arrived at between creators and consumers" (1980, 27-28). This is not to say that the punctum is, by contrast, *outside* of culture. Rather, the punctum represents an uncontrollable reactionary moment that reveals something unique about individual viewers.

Parts 1, 2 and 3 are thus all centred around these moments that "pricked" (Barthes 1980) me and perhaps could only prick me; moments that evoked an uncontrollable reaction not immediately describable. In scoping out each case study

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[16] Lorna A. Rhodes has recently compared Barthes' punctum with the sparked interests of ethnographic writers. Though Barthes focuses solely on the static images of photography, Rhodes suggests that it is actually quite easy to extend the idea of the punctum to include the verbal realm as well. The same can be said, from my perspective, of any sensory encounter in the field or the armchair. As Rhodes argues, "…in the long process of moving from fieldwork to the published page, the ethnographer enters into a conscious relationship to the punctum, which becomes good both to think with and to write about…it is this conjunction of the social and the particular--the social in its particularity--that eventually becomes the fabric of ethnographic writing" (2015, 278).

from a punctum I embrace the modesty and partiality (Haraway 1992; Simandan 2019) inherent in my own research and context-making practices even as I attempt something approximating generalizable claims about 21st biomedical culture(s). As Barthes suggests, a punctum has the potential for a kind of expansion that generates a productive paradox, especially for my purposes: “while remaining a ‘detail,’ it fills the whole picture” (1980, 45).

The “whole picture” of this project concerns whether and how we might better and more equitably embrace and make productive the inherent indeterminacy of biomedical future(s). Significantly, a recognition of this indeterminacy is shared by the economists, STS scholars, cultural anthropologists, politicians, angel financiers, medical students and doctors, clinical researchers, private companies and both private and public academic institutions that make up but a *partial* list of the “we” that constitutes the relevant participants in North American biomedicine. This list must also include non-scientist citizens, who represent actual and potential patients, who have been asked to become increasingly “literate” (Devi and Aznam 2019; Hodson 2020) in the technical and social aspects of medical science but are often given insufficient tools for navigating either of these domains (Briggle 2012; Dumit 2012) or the ways they overlap.

Using my puncta as anchoring points, this dissertation provides a series of modest interventions into the discourse, design, practice and pedagogy of translational medicine. At the same time, it reflects what for me is an important encounter with my own field and set of practices, not to mention the possible ways in which translational medicine and STS might effectively come together.

My Role as Translator

For now, translational medicine seems here to stay. I thus see this project as an opportunity to navigate two defining aphorisms in feminist STS: “stay with the trouble” (Bellanova, Jacobsen and Monsees 2020; Haraway 2016; Metzger 2018) and “it could be otherwise” (Haraway 1992; Wajcman 2004; Woolgar 2014). Though related, these two mottos point in different directions. “It could be otherwise” emphasizes political agency and the importance of radical breaks from preformed ideas about the spaces, practices and institutions appropriate to the pursuit of science. On the other hand, “staying with the trouble” asks us to work within the inherent contradictions, power dynamics and infrastructures that expand and constrain any attempt at altering the technoscientific status quo. A deliberative approach allowed me to do both simultaneously and imperfectly, which is often as good as it gets. Each of my case studies embrace and work within the agonistic, capital-intensive, unidirectionally linear frameworks that shape a lot of biomedical innovation. However, my approach also allowed me to stage novel encounters, to imagine and deploy my own interventions and, ultimately, to provoke and collaborate with my interlocutors in the mutual design of shared contexts and imagined biomedical futures.

In the end, this work takes seriously a unique set of capacities that a combination of critical STS and cultural anthropology provides: the facilitation of my own politically fleshy and inherently flawed translations, “cross-cultural understandings” (Rubel and Rosman 2003), (what Latour [1993, 1996] sometimes calls “mediation”) and “interliteracies” (Franklin and Roberts 2006) between domains of power, knowledge and experience that are constantly negotiated and renegotiated in attempts to foster more equitable and inclusive, but *always* imperfect, biomedical futures.

part 1
THE DISCURSIVE LANDSCAPE OF TRANSLATIONAL MEDICINE

Y Sawl Sy'n Fy Nhrosi i
Erbyn iddo 'nerbyn i,
A 'mynedd a 'nhu mewn-i

Wedi mynd, a heb waed mwy,
Heb anadl, yn bibonwy,

Gall hwn, fel meddyg â lli,
Fy agor heb gyfogi,

A heb lanast, trawsblannu,
Tywallt ei hun i'r twll du.

Wedi gwneud y gwniadwaith,
Ni welwch ôl ei law chwaith.

A rhoed y doctor wedyn
Arnaf i yr enw a fynn.

To the One Who is in My Translating
By to him my receiving,
my brain and my insides
after going, without blood (any) more,
without breath, in ice,
this one will-be-able, like a surgeon,
to my opening without nausea.
And without mess, transplant,
put himself into the hole black.
After doing (of) the needlework,
Not you-will-see trace (of) his hand, either.
May-put the doctor then
On me the name which he-wishes.

To My Translator
Now you've received me, doctor,
With my brain and my insides

Removed, with no more blood
Or breath, in ice,

You can go ahead
And operate without nausea.

Perform a tidy transplant
Of yourself into the hole.

And when the needlework is done,
Nobody will see a trace of your hand.

Then you can make up
A name for me.

- Twm Morys, *Welsh/English/French*

CHAPTER ONE:

what *is* translational medicine?

> Words are names for things. In Plato's time, things were names for ideas–What better description of the Platonic Ideal? But are words names for things, or was that just a bit of semantic confusion? Words were symbols for *whole* categories of things, where a name was put to a single object: a name on something that requires a symbol jars, making humor.
>
> - Samuel R. Delaney, *Babel-17*

Research for this project offered a good excuse to walk…a lot. I could certainly use the exercise, but also needed to pinch my government issued pennies once it was clear I would be trekking between Toronto, Ottawa, Saint John and San Francisco over a tight six month stretch. Funding frugality aside, walking provided an immersive experience that revealed gradual changes in physical, cultural, social and economic landscapes that grounded the urban centres in which I worked. Walking also presented opportunities for briefing and debriefing myself on unfolding research, to reflect on the *discursive* landscapes shaping and shaped by my and my interlocutors' conversations about translational medicine. So I walked, from basements of relatives, hostels, university dormitories and interlocutor apartments where I slept at night to coffee shops, parks, industrial sites, classrooms, hospitals, research centres and taverns where I met those willing to show and tell me about translational medicine.

Part 1 traces my earliest travels across and between the discursive and physical landscapes of translational medicine. Trudging, dawdling and striding, I collected multiple definitions, narratives and practices of translational medicine. These disparate pieces of archival and anecdotal data set up a threefold argument that roughly holds Part 1 together:

1. People attach the full continuum of seriousness to translational medicine. It inspires everything from deeply held beliefs that it is a new, robust and actionable approach to research and innovation to hollow lip service paid to a catchphrase people think is necessary for acquiring research funding. Regardless of where on this spectrum individual researchers and policymakers fall, translational medicine has become politically, culturally, economically and ethically consequential as a name, category, concept and set of practices.

2. In some contexts, including my field sites at DMNB and UCSF, dominant discourses of translational medicine point to but fail to adequately address what translation itself means to them, and what a truly translational approach to biomedicine might be.

3. As a result of 2, some approaches to translational medicine risk failing to provide paths for better and more meaningful engagement with non-expert publics and non-traditional health and healing practitioners in shaping what gets translated, how, by and for whom, and for what purposes.

Central to my defense of these arguments is a somewhat Foucauldian engagement with the "discursive relations" of translational medicine, especially at the DMNB. In the *Archaeology of Knowledge*, Foucault (1972) emphasizes the ways in which discursive relations do not merely limit the foundations on which formations of knowledge can exist and interact. They are, rather, "at the limit of discourse" itself. In his words, discursive relations:

> ...determine the group of relations that discourse must establish in order to speak of this or that object, in order to deal with them, name them, explain them, etc. These relations characterize, not the language (*langue*) used by discourse, nor the circumstances in which it is deployed, but discourse itself as a practice (1972, 46).

In setting out that which must be excised from examinations of discourse, Foucault argues that it is critical, in the name of "methodological rigour," to begin by questioning "ready-made syntheses, those groupings that we normally accept before any examination, those links whose validity is recognized from the outset" in the interest of first concerning ourselves "with a population of dispersed events" (1972, 22).

This is particularly important for studies of translational medicine. There has been a global dispersion of events, ways of understanding what translational medicine can and should be. This has made it impossible to categorize translational medicine as a unified name, concept or set of practices (re-)configuring how biomedical knowledge is constituted and disseminated (Anastasio et al. 2013; Cohrs et al. 2015; Fort et al. 2017). Yet, there is an emerging sense of what can be said and who can say it in specific sites of translational medicine. At the same time, counter-narratives can emerge, pushes and pulls from the political, academic, corporate and activist fringes of health, healing and biomedicine (Nussenblatt, Marincola and Schechter 2010; Zimmerman, Singleton and Welch 2010). These all have implications for the bodies, minds and socio-economic realities of the people meant to benefit from biomedical translations. Discourse, it seems fair to say, is always in a process of becoming (Olssen 2014, 30).

Following Ruth Wodak and Michael Meyer (2009), I adhere to an inclusive understanding of what constitutes discourse, allowing for richer if more challenging engagement with emerging registers, styles, channels, genres and practices of thought, language and action in biomedical communication:

> [D]iscourse means anything from a historical monument, *lieu de mémoire*, a policy, a political strategy, narratives in a restricted or broad sense of the term, text, talk, a speech, topic-related conversations, to language per se. We find notions such as racist discourse, gendered discourse, discourses on un/employment, media discourse, populist discourse, discourses of the past, and many more – thus stretching the meaning of discourse from a genre to a register or style, from a building to a political programme (3).

By embracing a multi-mediated and multi-modal understanding of discourse, contemporary approaches to CDA extend and complicate Foucauldian tracings of how and through what channels power manifests itself in daily life (Donoghue 2018; Lazar 2018; Mullet 2018). As a result, I have tried to remain equally sensitive to words spoken and written, still and moving images, interactive digital platforms, and ways of organizing spatial environments that all reflect "statements" (Foucault 1972) made about translational medicine.[17]

By way of introducing the deliberative dimensions of my approach, Part 1 presents more than descriptions and critiques of discourses of translational medicine in particular settings.[18] I am also mindful of the complex ways in which discourses of translational medicine have become physically manifest in the spaces and places of biomedical research and practice. This is a key, if sometimes misunderstood, aspect of Foucault's understanding of discourse. Discourse is historically contingent, a system that produces meaning and knowledge, useful both to those in power and those resisting power (Diamond & Quinby 1988). Discourse is also materially consequential, meaning that its effects are traceable in social interactions, in building designs and in the organization of institutions. As Weedon (1987) puts it, discourse refers to:

> ...ways of constituting knowledge, together with the social practices, forms of

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[17] Statements, for Foucault, are understood as any combination of signs that make up a field of enunciation, a flexible definition that makes multi-mediated analysis possible (1972, 78). Gilles Deleuze, describing Foucault's understanding of statements, emphasized that "there is no point in distinguishing between the different types of intentionality" (Deleuze 1988, 8), which is critical to my argument that translational medicine is consequential regardless of the seriousness with which statements are made about it. Viewing CDA and FDA somewhat interchangeably, I want to acknowledge the relatively open-ended approach I take to discursive and rhetorical analysis. I champion an "eschewing of claims to objectivity and truth by those in" poststructuralist approaches (Graham 2005) to discourse. Rather than Foucault himself, the connective tissue here is more likely an approach to "theorising that rests upon complexity, uncertainty and doubt and upon a reflexivity about its own production and its claims to knowledge about the social" (Ball 1995, 269).

[18] I more broadly attend to the intertextual and re-contextual dynamics of multiple and competing discourses within the spaces, practices and sub-genres of translational medicine (Iedema 1997; Iedema and Wodak 1999; Muntigl et al. 2000). I am mindful that "power is about relations of difference, and particularly about the effects of differences in social structures" (Wodak and Meyer 2008) rather than a preformed, unified hierarchical imposition on unknowing subjects. Like scholarship across many fields of research and action, this amounts to challenging deterministic explanations for dynamics of power and knowledge in technoscience (Hauer 2017; Marx & Smith 1994; Pitts-Taylor 2017, 2019).

> subjectivity and power relations which inhere in such knowledges and relations between them. Discourses are more than ways of thinking and producing meaning. They constitute the “nature” of the body, unconscious and conscious mind and emotional life of the subjects they seek to govern (108).

One of the most striking findings in my research is that the material consequences of narratives and counter-narratives of translational medicine result from more than the intentions or levels of sincerity behind statements of individual practitioners, research sites or funding organizations. Rather, translational medicine is made up of a wide and unruly network of discursive relations. This challenged me to be wary of overestimating individual claims about the necessity and efficacy of translational medicine, to move somewhat uncomfortably between the actor specific and the emerging contours of much wider discursive landscapes. As you will see, the discursive relations of translational medicine have become embedded in diverse biomedical sites, practices, approaches to funding and resource allocation, and ways of defining what, by whom, for whom and for what purposes specific domains of biomedical knowledge *come* to matter (de la Bellacasa 2017; Latour 2004, 2008; Law 2004) and *become* translatable (Landi, Everitt and Berridge 2021; Wendler & Wehling 2017).

It is in the messy middle of these relations that my work begins, and where it ultimately ends. I invite you to tag along across and between the uneven trails of translational medicine’s discursive landscape. This hike is one with many pit stops, pitfalls and sometimes pitifully mixed definitions, myths, metaphors and practices.

The Concretization of Translational Medicine

Early in my research, friends, colleagues and interlocutors were quick to dismiss translational medicine as a hollow rhetorical catch-all, with “translation” serving as a fleeting and meaningless metaphor for a process and policy context of research commercialization that remains relatively unchanged since the publication of Vannevar Bush's (1944) *Science: The Endless Frontier*. In this framing, translational medicine is nothing but a slightly updated re-articulation of the need to bridge gaps between so-called basic and applied research. Translation thus represents nothing more than unidirectional movements "from bench to bedside," a frustratingly overused and taken for granted turn of phrase in popular and academic descriptions of translational medicine.

November 2011 was the first time I heard an argument dismissing translational medicine as neither a novel or meaningful concept and set of practices in biomedicine. It came from a prominent Canadian cancer researcher responding to a panel on "Translational science and the hidden research system in universities and academic hospitals" at the Society for Social Studies of Science (4S) conference in Cleveland. Their point was that translational medicine was nothing new and added "little" to perceived distinctions between basic and applied research. Specifically, they called it a "silly catchphrase."

In the weeks and months that followed, I became aware of a number of similar dismissals from anthropologists, historians and sociologists of science and medicine from across the STS spectrum. In 2012's *Cancer on Trial,* for instance, Peter Keating and Alberto Cambrosio characterized translational research as a "catchphrase" and "the most recent organizational expression" of the coming together of biology and medicine since the mid-20th century (350). Anthropologist Kaushik Sunder Rajan and STS scholar Sabina Leonelli were also quick to move beyond "translation" as the focal point of their treatment of translational medicine. They suggested instead that it might be productive to question to what extent translational medicine has to do with translation at all. As they put it:

> We locate our concern with translational research, then, not in an analytic that is confined to translation but in one that is more broadly concerned with a biomedicine "in the trans-"—what might be called, following Sarah Franklin [2006], "transbiology." We wish to situate this concern in a conjuncture of globalizing, postgenomic biocapital (Sunder Rajan and Leonell 2013, 467)

I am sympathetic to this broader concern with a biomedicine in the "trans-", and actively experiment with it in parts 2 and 3 of this dissertation. However, I have long worried about situating translational medicine, from the outset, as extra-translational *and* within the context of "globalizing postgenomic biocapital." It has long been my contention that these deflections do very little to address the literal, material and global consequences and manifestations of translational medicine that have emerged over the last 30 years. Dismissing it as a hollow catchphrase or misplaced metaphor removes from conversation a much richer, messier and more engaging understanding of what translation is and how it works in uneven cross-cultural encounters. It also ignores the concrete physical and social spaces that have popped up in the name of translational medicine around the world.[19]

The literal concretization and international migration of translational medicine makes it especially important to take seriously that, in the words of geographer and STS scholar Gail Davies, "[t]here is much at stake in the *idea* of translational research for

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[19] The same year that I began tracking dismissals of the material and discursive significance of translational medicine, the United States National Institutes of Health (NIH) was getting ready to open their "shiny new" (Wadman 2012) National Center for the Advancement of Translational Sciences (NCATS), a complex of research and administrative buildings in Bethesda, Maryland. Officially opened in January of 2012, NCATS supports research across the "full spectrum" of translational medicine, including basic research, pre-clinical research, clinical research, clinical implementation, and public health (Collins 2011). NCATS is just one of many examples of the infrastructural and political sustainability of translational medicine. Not to mention that translational medicine has "gone global" (Alving et al. 2013; Shahzad et al. 2011), with policy initiatives and research centres popping up in geopolitical contexts as diverse as Singapore (Coopmans, Graham and Hamzah 2012), Bangalore, San Francisco, Glasgow, Tempe, Sydney, Beijing (Wang 2015), Shanghai (Wu et al. 2013) and Saint John.

experimental practices, for corporate actors, for patients and for communities" (2012: 128, emphasis added). I slightly rework Davies' statement by asking two critical questions:

1. How are the *multiple* ideas, practices and materialities of what translational medicine can and should be co-produced by distinct and sometimes conflicting hopes, aspirations and expectations for the future?
2. How can diverse publics, implicated as patients, research participants, activists and taxpayers, be more actively and creatively engaged in shaping the contours of translational medicine?

These questions have helped me navigate a ubiquitous argument proponents use to highlight the "power" (Bixby 2011; Carr 2009; Evers et al. 2019; Imyanitov 2013; Kaushansky 2004; Unger-Baillie 2015) and "necessity" (Anderle and Huyhn-Do 2017; Fallica 2011; Mankoff 2004; Roco, Bainbridge and Tonn 2015; Zheng, Yi and Le 2015) of a translational approach to biomedical research funding and practice: that it can foster a greater equilibrium between human health and economic prosperity. Successful translation, proponents say, requires cooperation between a range of public and private stakeholders, including non-scientist citizens (Mirnezami, Nicholson and Darzi 2012; Woolf 2008; Zerhouni 2004). Though many have argued that the public needs to play "decision-making roles" (Marincola 2003, 2007; Zerhouni 2004) in shaping what translational medicine is, it has been left unclear what these roles can or should be.

Breaking in a New Pair of Shoes

Research started in earnest in Ottawa during a scorching week in June of 2013, with a 3.5km stroll from my cousin's basement in Westboro to the University of Ottawa Heart Institute (UOHI) on Ruskin Street.[20] Having left in a sportcoat and button up shirt I

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[20] It would be an understatement to say that the first months of my research were fraught with anxiety. The stops and starts were beginning to be too much. For three months I had been working towards conducting fieldwork at the UCLA Clinical and

quickly regretted my sorry attempt to look the part of a professional academic in 35 degree Celsius heat. Sweating through the early morning climb, I tried to focus on a strategy for my first set of interviews with medical doctors, researchers and ethics advisors at government funding agencies in Canada's capital. As my surroundings shifted from middle-class houses and hipster stationery stores to eight-lane roads, cement overpasses and sprawling brutalist office buildings, I decided no strategy was the only strategy. There was still just one question I was determined to answer: "What *is* translational medicine?" It was a deceptively simple question, one I had been pondering since the first semester of my doctoral studies, and one for which I had nowhere near a coherent response.

"It's not so much that it's nothing, but it is impossible," Dr. Darryl Davis tells me just minutes after my arrival at UOHI. Dr. Davis identifies as a clinician-scientist, a hybrid practitioner who both conducts research and offers primary services to patients. Though they have existed since at least the late 1800s, the training of clinician-scientists–or even *clinician-scientist-teachers* in the ideal set forth by William Osler in the 19th century (DeLuca, Ovseiko and Buchan 2016)–is a critical foundation on which to build a truly translational approach to biomedicine (Roberts et al. 2012; Lewinson et al. 2015). Dr. Davis saw value in building more thoughtful intersections,

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Translational Science Institute. On a trip to Los Angeles in March of 2013 I managed to set up an interview with an oncologist who was developing a research project that turned "patient homes into laboratories" in populations either underserved by or untrusting of biomedical intervention. What made the project and the practitioner so compelling was his interest in anthropology, history, and music, the three domains through which my scattered thoughts about biomedical cultures are most often funneled. He wanted to incorporate music therapy into his research and to eschew, as much as possible, the question of "commercialization" in his efforts to translate knowledge into health. He seemed genuinely excited at the prospect of working with someone who could "tell the story" while remaining sensitive to the cultural and ethical borders he imagined himself traversing. From my perspective, it was exciting to get in on the ground floor, to navigate how and to what extent such a unique, refreshing and risky take on the translational possibilities of biomedical knowledge might be successful. (There was the added narrative bonus of the project being designed and deployed from the oncologist's office at the David Geffen School of Medicine). After this initial meeting we began to put the pieces together to have me join the project. For weeks following we spoke back and forth via email and on the phone about the necessary paperwork (visas, CVs, ethics protocols, etc.), and shared publications that we thought might help us better understand each other's perspectives. Then, suddenly, responses to my emails became fewer and further between. By June, nothing. It is not my place to speculate why our correspondence ended, but it is worth noting the panic that swept over me. With no established field site, and a mounting concern that I had "no project" at all, I hopped on a train to Ottawa and began setting up interviews with medical doctors, researchers and representatives from two major Canadian biomedical funding organizations.

where research and clinical practice more effectively and immediately engage the bodies of patients and research participants. Yet, he also wondered how this could lead to anything other than practitioners getting stretched too thin, modestly competent in two or more areas, but specialist in none. “There’s a real danger,” he warned, “in terms of doing the work to help people in the short and long-term.”

In our conversation, Dr. Davis seemed keen to locate the labour of translation within individual practitioners harnessing two sets of skills in one fallible fleshy vessel of human knowledge and practice. “Physicians,” he suggested, “do need to be able to keep up as much as possible with research, but whether they need to *do it* is beyond me. I try my best, but often feel I am falling short in each.” Dr. Davis’ concerns represent a growing recognition that the ideal of a clinician-scientist is daunting in an era of increased specialization and complexity in the domains of both bedside medicine and clinical research (DeLuca, Ovseiko and Buchan 2016). Though there are increased calls for clinician-scientists to spearhead translational medicine’s future, there has been an overall decline in those trained in both research and clinical practice actively conducting research (Roberts et al. 2012: 266).

For Dr. Davis, the labour of translation in this context is relatively straightforward. Clinician-scientists are simply taking “good knowledge” and adapting it to patient interactions “more quickly and with the least possible risk of harm.” Pressing further, I asked Dr. Davis “what is translation in your work? How do you *do* it?” Scoffing a bit, he suggested that it was simple, to the point that the word itself was not really worth analysing. “You find the best new stuff and see how it works.” Caught a bit off guard, I replied that I was “just fascinated by the very idea of translation in this context and, you know, what it means to you, and how you actually do it.” Dr. Davis seemed confused about why I would find this interesting, so I offered that translation was also an important concept in sociology and anthropology, as well as the history of science and medicine, and that it is overall an important if somewhat difficult to understand human practice. “I don’t know about all that,” he replied, “I just know that it’s good to be able to play between different domains…I’m just not sure it is ultimately going to do anything for anybody. It’s interesting, yes, but I don’t know.”

Dr. Davis had thought very little about what that central word, *translation*, was to him and his work. He was merely compelled to care because it was a “trendy thing, a box” he needed to check off on funding applications, and a professional designation to which he felt increasingly obligated to identify. For him, at most, translational research was a new way of articulating the need for medical experts to be better equipped to help patients. It was not, however, an invitation for him or his colleagues to redefine the kinds of knowledge and practice best suited to securing that help.

Walking back to Westboro from Dr. Davis’ office, I began to wonder if my becoming so engrossed with translational medicine, with what it meant and how it might expand or limit possibilities for better biomedical futures, was a mistake. Most striking, I thought, was Dr. Davis’ lack of interest in having a conversation about translation. He had little use for my attempt at engaging with broader debates about translation in academic and professional domains both outside and adjacent to his. He did not seem to want to play across or between my domains of experience and practice.

Finding My Footing on Uneven Ground

In general, the first days of research in Ottawa revealed flaws in my incoming assumptions about the reach and relevance of translational medicine. Translational medicine–along with its discursive siblings and cousins, translational research, translational science, and knowledge translation–was popping up all over the place in the months and years leading to my first trip to the field. In the titles of emerging multidisciplinary medical and scientific journals, new undergraduate and graduate degree programs at medical schools around the world, in funding agency roadmaps for the future, and in opinion editorials for major newspapers. It had, and still has, a major monetary and discursive cache. Yet, it didn't seem particularly interesting to the first few practitioners I spent time with. The problem wasn't just whether they thought translational medicine was interesting, but they seemed closed off to what I thought made translation so powerful and politically messy to begin with. Especially through my training in cultural anthropology and STS–the latter of which has been referred to as a "sociology of translation" by French and cyborg feminist practitioners (Best and Walters 2013a, 2013b; Brown & Capdevilla 1999; Callon 1984; Haraway 1992; Law 1993; Star and Griesemer 1989)–I had taken for granted the notion that translation is a politically, culturally, technologically and economically unbalanced and imperfect attempt at cross-cultural exchange. I had yet to realize the need for me to actively set the conditions and make the contexts (Asdal and Moser 2012) within which the fleshy politics of biomedical translation could be meaningfully engaged.

The night after I met with Dr. Davis, I had a rejuvenating conversation–over a delightfully and redundantly carb-loaded meal of pasta and beer–with Karine Morin, the (then) director of Genome Canada's GE3LS ("Genomics and its Ethical, Economic, Environmental, Legal and Social aspects") program. An ethicist and lawyer, Karine was an emerging player in *translational ethics*, having worked with philosophers and historians of science on a series of short but influential papers published in the

American Journal of Bioethics in 2008. Morin's contribution to the special issue, on the ethos and ethics of translational research, was titled "Translational research: A new social contract that still leaves out public health?" Her piece argued that there were fundamental issues with the way translational medicine had been defined, particularly its lack of direct alignment with public health concerns, an area of research and engagement Karine thought was well suited to offering a platform for non-expert publics to shape what translational medicine is and how it might be practiced. She lamented the widespread use and misuse of the term, especially its assumed connection to linear models of research commercialization.

"It's a lot like the word 'innovation'," Karine told me, "you know, the whole issue with everyone using it, misusing it, developing their own definition, and then making it meaningless." I suggested this was one way to look at it, but that did not mean there was nothing to salvage from the word or concept. "I wonder," I offered, "if sticking with and reimagining translational medicine might be worthwhile." "No no, that's right," she replied, "but people have to do the work, they have to get together. That doesn't happen here."

The "here" Karine refers to is Ottawa, a locus of power where the real work of translational medicine should be unfolding. For her, this is where researchers, funding agencies, private corporations and diverse publics should be labouring in tandem to find new and more collaborative models of improving health at individual and population levels. As she put it, "that would be *truly* translational." This work, in her mind, does not happen "because it does not have to." Karine suggests that, like Dr. Davis, many people are happy to pay lip service to the perceived power and necessity of translation in biomedicine, but do not see the need for making proactive or reactive commitments to particular approaches to translational research and ethics. Rather, they use it as trendy code for old, linear models of "innovation" and "commercialization." For Karine, these are "lazy models" designed to impress upon the public that, if the experts can be left alone as experts, then eventually "good research will find its way into the hands of good doctors" and, ultimately, into the bodies of good, freshly adherent biomedical subjects.

Noting that I seemed to have a particularly "philosophical" interest in translational medicine, Karine thought she had just the person to work with me. By the end of our third beer, she had put me in touch with the head of ethics for another major Canadian research funding agency, the Canadian Institutes of Health Research (CIHR), and urged me to meet him for lunch at the exact same restaurant the following day. Bureaucrats, it seems, try not to venture, by foot or other means, far from spaces and practices of close proximity and familiarity.

Just Call Me "Grasshopper"

So, a mere fourteen hours after my supper with Karine, I found myself waiting nervously in the same corner of the same restaurant, for a man I was told would be excited to talk more "philosophically" about translation, medicine and ethics. My anticipation and nervousness heightened my senses. Overnight and on my hike over, I had convinced myself this was going to be the real start of my work, the first deep tracks I was going to make on translational medicine's trail. While I waited, the heaviness of summer weighed on me despite a powerful central air unit blowing overhead. A blender exploding in the kitchen produced a jolt in my shoulders, and the smell of smoked meat emanating from the deli counter was aggressively appetizing. I was nervous, excited and hungry. When the director of ethics arrived, bearded, sweating and holding a ragged briefcase, I stood up, shook his hand and tried to find my footing.

After preliminary introductions, he looked up from his coffee and simply asked, “So, what are you?” “Well,” I replied, “as mentioned in my email, I’m a graduate student at York University, doing a project on the history and anthropology of translational medicine.” He paused briefly, giggled a little, and simply said, “okay, well, what can I do for an anthropologist?” Feeling the need to connect more directly, I began explaining that I also have a background in philosophy and information science, and have long been interested in the idea and practice of translation, specifically how human beings use it to connect across difference and inequality. “Oh sure, sure, you have it all,” he responded, chuckling once more and revealing that this was perhaps not going to be the big break I was hoping for.

Over the course of a couple hours, this director of ethics sat back, calm and calculated, in his wooden chair. He reveled in my nervous energy. Our conversation leapt from Wittgenstein to role-playing games to the confusing funding arrangements of Brazilian biomedical research. He kept calling me ‘Grasshopper’ – a reference to the 1970s television series and textbook example of Hollywood Orientalism, *Kung Fu*[21] – assuming, by default, the role of master. Though I tried to get the conversation focused on the ethics of translational research, he seemed irritated with me, determined to drive home a point about how I and my so-called “kin” – fellow graduate students interested in the history, sociology and anthropology of biomedicine – present ourselves to the

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[21] In a famous flashback, Caine, the half-Chinese, half-American protagonist (played by white American actor David Carradine) is asked by Po, his blind master, to close his eyes and describe what he hears around him. After describing a nearby fountain and birds in a cage, Po points out that Caine has failed to perceive the beat of his own heart or a grasshopper at his feet. From then on Po refers to Caine as ‘Grasshopper’. Often understood as an affectionate term for a neophyte, referring to someone as ‘Grasshopper’ is also a way to generate the uneven dynamics of power and knowledge that informed the interview described in this vignette. Referencing *Kung Fu* also points to a generational divide in the conversation, as it participates in Orientalist discourses that were normalized in the 1970s and have since been criticized (Iwamura 2011, 115).

physicians, researchers and patients with whom we work. He implied that we were too eager *and* too anxious. He suggested that we would never be able to account fully for the technical expertise and mundane experiences that informed his life and work. This was the life of a worldly medical doctor turned bureaucratic “paper pusher” working for an established arbiter of Canadian medical research ethics.

At one point I asked if it was safe to say that ethics are enacted in even the most mundane moments of his life and work. He sighed and told a heroic story of a plane trip he took in the late 1970s. He saved a man suffering from cardiac arrest by stabbing him with a hollowed out pen. He preferred that I listen, rather than telling him “what ethics are.”

The interview was both under and overwhelming in its lopsidedness. It would not surprise any scholar in STS or the anthropology of science and medicine to run into seemingly uncooperative interlocutors who privilege mainstream technoscience’s discourses, practices and power hierarchies (Star 1991; Haraway 1997). Yet, in many ways, the interview was exceptional. The director’s character and antagonisms provided a distinct and teachable moment in my early travels across the terrain of translational medicine. Any perceived failure in the interview did not result from a lack of evenness or equality in the encounter. Failure stemmed, rather, from a lack of shared context from which and within which we *imagined* we were engaging. In a word, our problem was translational.

I too easily took on the role of the student, the “Grasshopper,” suppressing a desire to ask follow-up questions that challenged my interlocutor’s assumptions. Neither of us did any active work to provide space for meaningfully and collaboratively translating our ways of knowing the world to one another, to come to some mutual ground on which to walk, however unevenly, together. More than anything, I was perplexed by the ethics director's emphasis on *his* knowledge, *his* practices, *his* stories; a posture I had wrongly assumed was counter to the collaborative and cross-cultural spirit of translational medicine.

Posturing is actually a fairly good word for what I am referring to. There is a hard-to-suppress need and desire to perform the role of expert and to align oneself with long presumed hierarchies between experts and non-experts in biomedicine (López-Rodríguez 2017). This made it difficult to pivot my earliest research interactions towards richer and more amorphous understandings of translation in non-medical fields of inquiry; fields that, if taken seriously, make up the real networks (Callon 1999; Callon and Blackwell 2007; Crawford 2020; Latour 1996) of collaborative labour that translational medicine calls for. So, rather than merely a noteworthy fieldwork story, this early interview contains much of my project's "whole picture" (Barthes 1980), including the deliberative hills I had to climb to find anything resembling stable, if always impermanent, ethnographic ground.

Carving a Path To Translational Medicine

The use of the word "translation" to describe a process by which basic research is converted into clinical practices first appeared in *PubMed* in 1993 (Butler 2008). The article made specific reference to the *BRCA1* gene and perceptions of its "immediate applications in early detection and treatment of breast cancer" (Machado-Vieira 2012).[22]

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[22] The discovery of BRCA1 and BRCA2 is regarded as a watershed moment in predictive medicine, a future oriented approach to utilizing molecular genetics that "does not focus on disease as such, but rather on the risk of developing a given disease at some future point" (Bourret 2005: 42). An indicator of risk instead of diagnosis, the test for BRCA mutations is recognized as a precursor to contemporary concerns with personalized and individualized medicine, identified as a "a departure from the statistical definition of family risk and a return to the body of the individual patient, who will recover her rightful place at the centre of the clinical process" (Bourret 2005: 49). The predictive and personalized qualities of BRCA1 and 2 testing, however, also need to be understood in terms of the cultural dynamics and geopolitical environments in which they are utilized. Shobita Parthasarathy has shown, in a

A two sentence abstract from Dr. James Geraghty's 1996 article, "Adenomatous polyposis coli and translational medicine," offers a telling early example of this emerging idea of translational medicine. I present Geraghty's work in detail, not because the technical aspects of his research are important to the rest of my dissertation, but because his foundational approach to translational medicine popped up again and again in my work in both Saint John and San Francisco. As he puts it:

> Translational medicine can influence clinical practice. The clinical message from recent research is that ileorectal anastomosis should be the preferred surgical option for polyposis in patients with mutations before codon 1250 and restorative proctocolectomy in those with mutations after this codon (Geraghty 1996, 422).

The debate over restorative proctocolectomy or ileorectal anastomosis as preferred treatments for patients with unmanaged ulcerative colitis, Crohn's disease or colon cancer had been ongoing since the 1960s.[23] Geraghty's excitement over a perceived consensus among clinicians did not follow from his own research but rather his interpretation of a paper by eminent Dutch cancer specialist Hans Vasen and colleagues that Geraghty thought highlighted both the value and immediate challenges of translating knowledge from molecular biology to clinical practice:

> The paper by Vasen and colleagues in this issue of *The Lancet* provides a clear example of how translational medicine can influence clinical practice. It addresses the long-existing surgical dilemma of the choice between restorative proctocolectomy or colectomy and ileorectal anastomosis in the management of familial adenomatous polyposis, an autosomal dominant disease due to a mutation in the adenomatous polyposis coli (1996, 422).

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comparison of BRCA testing in the United States and Great Britain, that "national specificities such as laws, institutions, and traditions have much more wide-ranging effects, both in shaping the new genetic testing technology and defining the roles of the individuals and healthcare professionals who used it" (2005: 6). Research on *BRCA* genes is ongoing, leading medical anthropologists Karen-Sue Taussig and Sahra Elizabeth Gibbon to call for increased collaborations between natural and social scientists in working through "continuous challenges for medical application *and* social scientists interested in understanding these research trajectories, their clinical dynamics, and the consequences of ongoing medical uncertainty for patient identity and health practice" (2013: 474).

[23] A restorative proctocolectomy removes the colon without alternating the pathway of bowel movements while ileorectal anastomosis connects the terminal ileum to the rectum after colon removal. As Siaperas and Hartley (2009) suggest ileorectal anastomosis is a "procedure…of great historical interest having been initially championed by Stanley Aylett from the UK, and used for over 50 years, as an alternative to proctocolectomy and permanent ileostomy for patients with ulcerative colitis" (78).

Geraghty's emphasis on the translational merits of Vasen's work suggested a possible future in which molecular biologists and clinical practitioners can more expediently communicate with one another, ensuring rapid movements of useful findings into the hands of clinical experts and the bodies of cancer patients.

The future imagined by Geraghty was based on expectations that translational medicine requires career-long continuing education for clinical practitioners in "the language of molecular biology." Translation in this case involves a unidirectional process of clinical practitioners training themselves to find, understand and implement the most immediately viable and transferable findings in basic molecular biology:

> There must be few better examples of situations needing continuing medical education than an ability to keep up with the explosion of information occurring in molecular biology. This view is endorsed by a statement from the American Society of Clinical Oncology on genetic testing for cancer susceptibility. In view of the impact that mutations in genes such as *APC*, as well as many others such as *BRCA1* and *BRCA2*, will have on clinical practice, the statement by this Society emphasises the need for additional education in molecular genetics for those already or likely to be managing these patients. The latter group includes those in undergraduate training, where the core curriculum must incorporate specific focus on the basic sciences relevant to modern clinical practice (Geraghty 1996, 422).

"Explosion of information" is a common phrase expressing late-capitalist and postgenomic hopes and anxieties about managing data and its attendant debris across molecular biology since the mid-twentieth century, the result of increased reliance on robust informatic and imaging technologies (Garcia-Sancho 2012; Hayles 1999; Kay 2000; Lenoir 1999; Richards and Hallam 2015; Sunder Rajan 2006; Waldby 2000). One solution, for Geraghty, was for medical students to be trained early to navigate "the basic sciences relevant to modern clinical practice" while recognizing that the dynamics of those sciences and practices will be in constant flux. Geraghty's description thus offers an interesting precursor to more contemporary understandings of translational medicine, particularly in its recognition of core issues like interdisciplinary education and communication, data management, efficiency and expediency and, most importantly, the necessity of bringing these together to more effectively detect and treat human disease.

It is this earlier definition of translational medicine that seems to have informed Dr. Davis' understanding noted above, one that is wholly focused on communicating biological knowledge and transforming it into improved clinical practices. Rather than training medical doctors to become researchers, it was more important and more realistic to train them to become fluent in the languages of fields and subfields of biological science. Karine Morin's work on the ethos and ethics of translational medicine by contrast represents a much broader and more inclusive understanding of what can or should be translated, how and for what purposes. As she noted in her articles and in conversations with me, there is more at stake for patients, research participants, doctors, researchers and non-scientist citizens than earlier proponents of translational medicine appreciated. It is much more than a rapid transfer of knowledge between distinct expert domains to impose new practices on the bodies of non-expert patients. Translation is not, in her words, "a linear process, and not one that can be divorced from broader cultural, political or ethical implications." Dr. Davis and Karine thus represent a core tension in translational medicine's discourses. They are individuals working to define and defend slightly different articulations of the scale and scope of translational medicine as a distinct name, category and set of practices.

Almost thirty years since their first usage and translational medicine, translational research, translational science and knowledge translation have all become "normal" parts of the biomedical lexicon (Musen et al. 2012)[24]. Well beyond the realms of molecular biology and cancer research, the intervening years have seen increased attention to the ways in which translation might represent a productive framework within which researchers, clinicians, policy makers, patients and commercial stakeholders navigate shared and conflicting goals across a wide range of environments, legislative platforms and practices (Mehić 2011). The last decade has also witnessed a number of projects emphasizing the need for novel approaches to studying the social and ethical implications of translational research (Atkinson-Grosjean and Lander 2011; Maienshein et al. 2008; Morin 2008; Vignola-Gagné 2014; Wainwright et al. 2009), or what Hostiuc et al. call "morality in translational bioethics" (2016: 1). This is a far cry from a (relatively) straightforward suggestion that clinical researchers become fluent in the language of molecular biology as a path to resolving debates over appropriate surgical practices in the treatment of specific subtypes of cancer.

The scope of translational medicine is ever-shifting (Fuster 2014; Hostiuc et al. 2016; Van der Laan and Boenink 2015; Yoon et al. 2018) and with it the models and discursive devices used to frame how the ambiguous and ambitious goals of its proponents might be achieved. A core assumption is that achieving these goals requires stronger connections between universities, hospitals, government funding agencies, and private pharmaceutical and biotechnology companies (Dickler et al 2008; Woolf 2008;

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[24] In trying to grapple with the wide and varied understandings of certain words and practices, a number of information scientists have developed initiatives to trace the "lexicons, terminologies and ontologies" of biomedical language (Bada 2014). In the context of bioinformatics, "ontologies" are "machine-processable descriptions of scientific domains that can promote the integration of disparate data sources" (Musen et al. 2012:). The NCBO's BioPortal is designed to connect more than 270 different biomedical ontologies allowing users to "compare the use of related terms in different ontologies, but also allow analysis of how whole ontologies compare with one another. They allow us to identify ontologies that cluster together and to identify the degrees of overlap among ontologies (Musen et al. 2012, 191). On the ontologies included in NCBO's BioPortal is the "Translational Medicine Ontology" (TMO) designed by the Translational Medicine task force of the World Wide Web Symposium Consortium's Health Care and Life Sciences Interest Group. Few initiatives highlight the *multi-translationality* of translational medicine more distinctly than the TMO. In 2011, the group, which was made up of dozens of biomedical researchers, bioinformaticians and semantic web designers introduced what they called the TMO and the "Translational Medicine Knowledge Base" (TMKB). The Semantic Web is an initiative to develop common data formats and protocols for exchanging information on the World Wide Web. More than anything, the Semantic Web is designed to facilitate the integration of diverse models and infrastructures for storing and communicating information between different user communities.

Lander and Atkinson-Grosjean 2011). Rather than a unidirectional movement from the lab to the clinic, more recent descriptions of translational medicine tend to emphasize a multi-directional (Seneviratne et al. 2019; Yoon et al. 2018) understanding of translation across and between a number of disparate stakeholders, technologies, environments and geopolitical locales. At the same time, many translational research initiatives maintain a stated interest in more equitably and strategically addressing the needs and desires of the diverse publics for whom these stronger connections are meant to serve (Dijkstra et al. 2018; Scudder et al. 2021). Translational medicine thus provides an exemplary reminder that "the molecular, the population and the life sciences are linked in…complicated ways" (Raman and Tutton 2009: 21).

The complexity of articulating what translational medicine is, how it should be practiced, what technologies it requires and who it should benefit is not something that can be resolved. It necessarily possesses an everything-all-at-onceness, making it equally likely to be engaged superficially by some and championed as a dynamic set of practices, research postures, environments and business strategies by others.

There is an elusive quality to translational medicine that reminds me that we are inevitably talking about an approach to biomedicine that is trying to reconcile multiple ways of thinking about and doing translation. The real issue is the *multi-translationality* of translational medicine. The more and more translational medicine starts to think about ethics, morality, sociology, advancements in bioinformatics, etc. the more it might benefit from the ways in which the politics of translation have been unmasked in literature, geopolitics, machine learning, molecular biology, and STS. This is not because these fields have something to teach translational medicine, but because translational medicine is starting to imply that these fields are themselves critical to its success (Hostiuc et a. 2016; Robinson 2017).

Implied Publics

As mentioned earlier, it is impossible to know whether to call translational medicine an idea, practice, field of inquiry, framework for cross-institutional partnership, or simply a convenient label masking already established models of biomedical commercialization. It is as important to some doctors, business leaders, government bodies and citizen scientists, as it is completely superficial and meaningless to others. Yet, regardless of its substantive impact on the paths down which biomedicine is traversed by individuals, translational medicine–as a name, domain, concept and set of practices–has proven to be profit, policy and career generating. Danger lies in translational medicine's slipperiness, in its capacity to be everything and/or nothing to specific biomedical stakeholders, yet no less *useful* regardless of where on that spectrum they find themselves. Translational medicine is discursively powerful enough to reach across global healthcare systems, policy platforms, academic publishing companies and biomedical innovation firms. It is also discursively hollow enough to be used and misused, appropriated to meet a wide range of politically, culturally and economically dubious goals in the name of improved healthcare outcomes for all.

At the core of most understandings of translational medicine is the "general public," (Dijkstra et al. 2018; Wolf, Clayton and Lawrenz 2018) the unhealthy, corporeally and medically non-adherent citizens, for whom the riches of knowledge, technology and power are to be literally and figuratively translated. With their combined efforts, proponents hope that translational medicine will "move the utility of interdisciplinary research ‘from bench to bedside’” (Rapp 2011: 673) as quickly and efficiently as possible. In order to do this, non-expert publics must be engaged in the process in various subject positions as patients, research participants and taxpayers, among others. As Steve Epstein has argued:

> Not just in the clinical encounter, but in increasingly varied settings ‘from bench to bedside’, biomedical experts do their work by coordinating or coercing the activities of laypeople – something they cannot accomplish unless they have some understanding of how people function in society (2008: 810)

In the rest of Part 1, I will highlight a particular site of translational medicine where there was a distinct privileging of economic and expert interests over those of the people meant to benefit from biomedical translations: the DMNB in Saint John. I was at the DMNB just as it was establishing a medical program focused on training clinician-scientists. At the same time, they were getting ready to open the doors to Dr. Keith Brunt’s brand new translational medicine research facility. The DMNB provides a unique context for understanding how some frameworks of translational medicine privilege academic, governmental and economic experts in negotiating its contours, even as these experts hail patients, their chronic illness experiences and their communities as the most important constituents of the translational medicine enterprise.

CHAPTER TWO:
empty pedagogical roads

It is an early Tuesday afternoon in October 2013 and I am sitting in a basement lounge with first and second year medical students at DMNB. Keith has brought me here to meet students and set up interviews for the coming weeks. As I enter, they put down their pool cues, snacks and smartphones and slowly let their multi-mediated conversations fizzle out. Keith describes me as someone interested in the historical and social stories of the school, emphasizing my interest in "student experiences." This proves to be a helpful pitch and the students lower their brows, expressions turning less confused and more engaged. Keith leaves so we can be "undisturbed by an authority figure" and I begin talking with these young doctors-in-training about the program and their backgrounds.

"In particular," I offer, "I am interested in how you are finding the *Research in Medicine* component of the program, especially its emphasis on translational medicine." Some students begin to laugh, one or two roll their eyes, and it becomes clear that the *Research in Medicine* program is not something they are particularly interested in. "It's kind of boring" seems to be the consensus, and students are generally confused by "this whole translation thing."

In the 2013-2014 academic year, first and second year medical students at DMNB and Dalhousie's main campus in Halifax would be the first cohort of Canadian medical students required to produce original research as part of their education. *Research in Medicine* (RIM)–a purposefully playful spin on Research in Motion Limited, the Ontario company that famously produced the BlackBerry–is meant to inspire students early on, in Keith's words, "to see that the way to navigate best practices and treatments is to stay up to date on research relevant to your areas of specialization." The larger goal was to build in as many students as possible an interest in producing original research as part of their professional ambitions.

This was all regarded as a way to streamline the training of clinician-scientists (Lockyer et al. 2014; Neul 2010; Schrier 1997) in the next generation of biomedical labourers. As noted earlier, clinician-scientists have long been an important if somewhat "rare species" (Schrier 1997) in academic medicine. Their rarity is in direct proportion to the amount of work it takes to train a medical doctor in both research and clinical practices (Schrier 1997). This was not always the case, as many medical practitioners in the 18th and 19th centuries were noted for their combined interest in research and practice (Starr 1982; Weisz 2006). Of course, the increased desire for specialization coming out of the 19th and into the 20th centuries made it increasingly difficult for any one person to do both (Starr 1982; Weisz 2006). This is something some proponents have suggested makes translational medicine critical to returning medicine to the assumed ideal set forth of William Osler (Leach and Coleman 2019). Successfully training clinician-scientists, by way of making research both mandatory and concurrent with students' other studies, was, for Keith, a "key pillar of success" for shaping a biomedical culture in Saint John founded on the principles and practices of translational medicine.

RIM requires students to produce a four year longitudinal study. Research will be ongoing throughout coursework, clerkships and residency appointments. The first semester of RIM is divided into two sections: 1) Core curriculum sessions and; 2) Translating research to practice sessions. Core curriculum sessions involve students working on small group activities while also learning to develop research questions, conduct literature searches, design research projects and collect data.

The sessions on translating research to practice involve learning about a number of projects at Dalhousie Medicine that are specifically geared towards the translation of research into improved health practices and policies. Within these sessions students are introduced to everything from clinical epidemiology, community outreach and population health to concerns about the relationship between basic science and healthcare policy.

Adding to the allure of RIM is the fact that DMNB only accepts incoming medical students who are already New Brunswick residents. Keith hopes that providing a "world-class education" to students from the province will incentivize them to stay or come back here to do research, work in New Brunswick's hospitals and set up family practices. There is a built-in assumption that these students already possess a greater sensitivity to the immediate health challenges facing New Brunswick's population. This, Keith hopes, will be one critical way in which DMNB's local focus might generate long-term global reach and influence. "Not only do we want people to get amazing care from well-trained physicians," Keith tells me, "we want to be a revered, scrappy, upstart research hub." Emphasis for him is on the local scale, and the ways in which it presents the most useful starting position from which to gain global notoriety. This is a point to which Keith and I will return throughout my time in Saint John.

Teaching Translational Medicine

A day after my initial meeting with DMNB students, I was invited to attend one of their first "translating research to practice" RIM classes. The lesson was delivered by Dr. Jill

Hayden, from the Department of Community Health and Epidemiology, and Dr. Robin Urquhart, from the Department of Surgery, at Dalhousie's main campus in Halifax. The DMNB group was supervised by Dr. Anil Adisesh, the inaugural J.D. Irving Limited Research Chair in Occupational Medicine at DMNB. I was seated at the back of the room, curious about the content of the lesson and excited to witness how students in Saint John use the bidirectional displays that connect them with colleagues in Halifax.

Anil enters, smiles, looks at me and says to the group, "I assume you have all met our, what do you want to be called…'visitor'?" The class nods and a few look back at me. Anil explains that the lesson is going to help them use databases to find up-to-date research on the topics they've chosen for their four year studies. As a result, this lesson would serve as a sort of bridge between "core curriculum" lessons and those more specifically focused on the language and practice of translation. Before opening a line to the group in Halifax, Anil pauses and offers that he knows "this is going to be a bit of a drag. Databases are forever boring." This proves to be a telling way to kick off the class's introductory foray into translational medicine.

The title of the lesson is "Systematic Reviews and Knowledge Translation," with Dr. Hayden delivering an overview of approaches to developing systematic literature reviews. Dr. Urquhart will conclude with a lecture on the benefits and challenges of translating knowledge as efficiently and expediently as possible. Overall, the goal is to "pique student interest" and to remind them that there are more "active ways of knowing" than simply reading and regurgitating information from textbooks and journal articles.

What fascinated me about this lesson was that, for most students, it would be their introduction to translational medicine. It was the first time *translation* would be defined as a name, category and set of practices. In this lesson, translation is immediately framed around the notion that, even at a patient's bedside, an evidence based approach is crucial. As Dr. Hayden puts it, "[e]vidence based practice is an integration of clinical expertise, external research and patient needs/desires." This ideal is almost impossible to meet, she explains, because doctors working in hospitals and independent family practices are ill-prepared for keeping up with research. This is because "the reality is a pile of confusing documents. There are 25 000 medical journals published every year. You'd have to keep up with 650 articles per month to keep up with information related to your field. It's not feasible." Navigating this, what many have previously described as an "explosion of information," requires a strategic and systematized approach to finding and combining relevant studies. As a result, Dr. Hayden recommends R.B. Haynes' "well-known" 5S model for building systematic reviews.

The 5S model is most often rendered as a pyramid. At the top are "Systems," most commonly identified as computerized decision support tools like a patient's health records being linked with the best current research on a specific health issue. The level below is "Summaries," referring to broad categories and guidelines for best practices. The third level is "Synopses," associated with peer-reviewed journal articles. Below Synopses are "Syntheses," the main focus of this lesson. The bottom level, "Studies," is made up of original research that provides the raw material foundation on which the rest of the pyramid is built. Some have added a sixth level to the pyramid, "Expert Opinion," that includes review articles and textbooks, material that, in non-research focused medical education, would be the main medium through which students gain knowledge.

Systematic Reviews as Original Translations

Dr. Hayden suggests that students have to be "transparent" in their approach to systematic reviews and learn to recognize that synthesizing research can be a messy endeavour. Systematic reviews are distinguished from narrative reviews that critically "describe and discuss the state of the science of a specific topic or theme" but do not "list the types of databases and methodological approaches used" (Rother 2007, vii). A systematic literature review, on the other hand, "is a well planned review to answer specific research questions using a systematic and explicit methodology to identify, select, and critically evaluate results of the studies included in the literature review" (Castro 2006). As a result, systematic literature reviews are considered "original" works because they are conducted using "rigorous methodological approaches" (Rother 2007, vii). A major selling point of systematic reviews is that they are often more efficient and expedient than producing new studies because they carefully aggregate existing data and possess built in "quality control" mechanisms for determining the methodological integrity of individual clinical trials (Verhagen et al. 1998, 1235).

These first year medical students are being introduced to the bare bones components of systematic reviews: 1) clearly formulated research questions; and 2) comprehensive search strategies for identifying relevant studies. "Good" questions and research strategies will help students avoid being "misled," allowing "decision-makers" to focus on the local applicability of studies and also to "constructively contest research evidence." Dr. Hayden does not elaborate on what a decision-maker is, or what it means to contest research evidence, but it is undeniably refreshing to hear first year medical students introduced to something akin to Haraway's (1991, 1997) emphasis on the situatedness of research and knowledge production early in their education.

Asking a good question, for Dr. Hayden, requires specificity and clarity. The most important consideration is “who cares? Who are the stakeholders?” Developing the “architecture” of a good question involves following what is commonly known as the “PICO” strategy. PICO is an acronym for “population, intervention, comparison, and outcome.” Each of these components need to be built into systematic review questions if the subsequent review is going to be reliable. Dr. Hayden then provides examples of “potential” vs. “better” questions.

A potential question might be, “Is vitamin C effective in treating a cold?” A *better* question would be both more robust and more narrow in focus: “In adults with common cold, is vitamin C, at doses of 0.2g daily or more, effective at reducing the duration of severity of symptoms, as compared to placebo?” The population is “adults with common colds,” the intervention is 0.2g or more of vitamin C per day, the comparison is between those taking vitamin C and a control group taking placebos, and the outcome is whether and to what extent the duration of severe cold symptoms is reduced. Dr. Hayden claims that the benefit of PICO-driven review questions is that they are “transparent, minimize bias and facilitate subsequent steps.” With greater clarity and transparency comes a reduction in “noisy” studies that might fit into a broader set of *potential* questions but will not adequately address local, narrowly identified health concerns.

The final step is determining the quality of studies that result from well-defined questions. This is where a medical doctor’s “clinical judgment” becomes an important part of the equation. The real work of developing a systematic review is “interpretative,” and it is here that a kind of translation becomes important. A robust initial question is only as good as the work done to navigate the “heterogeneity” of studies. This, of course, requires that doctors possess knowledge of both clinical settings *and* the languages used within specific research disciplines. As Dr. Hayden puts it, clinicians and doctors must weigh similarities and differences between studies in order to “assess if it makes sense to combine” them. Questions include:

- Is the population similar enough?
- Is there clinical or statistical heterogeneity?
- To what extent can two research projects be compared and acceptably combined?

Dr. Hayden’s key message is that, when you look at a body of evidence, it has to make sense to combine and aggregate individual studies into a systematic review. In other words, the research that makes up the review needs to be trustworthy.

The underlying assumption here is the same one that informed Dr. Geraghty’s interest in translational medicine in the mid-1990s, discussed in the previous chapter. Medical students need to know first and foremost how to read and engage with the language of multiple research disciplines (such as molecular biology and biochemistry) if they are going to develop the skills to ask the right questions, interpret results and aggregate studies into useful systematic reviews. The ultimate goal appears to be: train students to build and interpret resources like systematic reviews in order to more efficiently and expediently “influence clinical practice” (Geraghty 1996).

This emphasis on efficiency and expediency is critical to a number of definitions of translational medicine, and a core goal for many of its proponents (Feldman 2008; Suchkov, Notkins & Marshall 2018). Yet, what is often unclear is how efficiency and expediency are to be defined, and in how many directions efficient and expedient flows of knowledge are meant to travel. Nearing the end of this first half of the lesson, I was impressed with how quickly the technical and information science dimensions of translational medicine were being introduced to students. Dr. Hayden emphasized that students had to be aware of their audiences, whether colleagues, patients, loved ones or other stakeholders. This was described as key to developing nuanced interpretative skills when producing systematic reviews "as original translations of existing knowledge."

What is "Knowledge Translation"?

Dr. Hayden yields the podium to Dr. Urquhart and a title slide for the second half of the lesson pops up, containing only two words: "Knowledge Translation." Opening her remarks, Dr. Urquhart suggests that "knowledge translation is relevant to all of you, regardless of your projects." She then expresses concern about time gaps between basic discovery and meaningful changes in clinical practices. "New discoveries, new, new, new," she says enthusiastically, "but we already have so much that is discovered and don't translate that into clinical practice, and practice is basically still based on criteria from 30, 40, 50 years ago. We have not translated a single thing." The assumption is that practices *should* have changed and *would* have changed, if not for a seemingly arbitrary separation between basic research and clinical practices. A set of similar concerns have long been used to push for a translational approach to biomedical innovation (D'Adamo, Widdop and Giles 2021; Littman et al. 2007; Woolf 2008) .

Emphasis again is on training medical students to search for, evaluate and integrate knowledge from a number of disciplines in order to more efficiently and expediently reshape clinical practices. However, Dr. Urquhart is quick to provide a much broader understanding of what it means to translate knowledge in biomedicine by way of the CIHR's current definition of knowledge translation:

> Knowledge Translation is a dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically-sound application of knowledge to improve the health of Canadians, provide more effective health services and products, and strengthen the healthcare system ("Knowledge Translation at CIHR," para. 4).

Dr. Urquhart points out that how translation is defined and practiced is always in flux. She also suggests that translational medicine is "different across disciplines and countries, but there are crucial connections between them all." As she moves on to dissect CIHR's definition, I jot down in my notebook, "but what <u>are</u> those connections?"

Elaborating on CIHR's definition, Dr. Urquhart says that "dissemination" means identifying appropriate audiences then tailoring the format and tone of "messages" to those audiences. "Knowledge exchange" refers to interaction between "knowledge users," who share results in the interest of "mutual learning." Knowledge users might refer to policymakers, researchers in other fields, patients, research subjects, or representatives from biotechnology and pharmaceutical companies. At this point we return to the question of "decision-makers" left open-ended by Dr. Hayden.

Dr. Urquhart suggests that all knowledge users are "decision-makers." Patients, activists, doctors, biologists, private companies, etc. might fall into this category depending on the stakes and scope of particular translational initiatives in biomedicine. A translational approach, for Dr. Urquhart, is thus necessarily collaborative. Knowledge users must work together "as partners in the research process." It is out of these collaborative research processes that the application of knowledge, described as the "iterative process by which knowledge is actually considered, put into practice or used to improve health and the health system," can be achieved.

From here, students are introduced to two "paradigms" of knowledge translation.

The first is the "transfer paradigm" where researchers unidirectionally communicate their findings to relevant knowledge users. The second is the "engagement paradigm" in which "researchers and knowledge users choose topics and interpret results together." The engagement paradigm distinguishes itself by way of recognizing that everyone involved, including patients, brings their own "expertise" to the collaborative process. This calls for a flexible approach that can be "adapted to specific contexts." Dr. Urquhart makes clear that the ideal is always to strive for the engagement paradigm, though "the situation often ends up looking a lot more like the transfer paradigm." In part, this is because people tend to privilege the role of experts in determining how best to understand individual and population level health concerns. Still, she encourages students to take seriously how they might better engage patients, loved ones and other stakeholders in working together to overcome healthcare challenges, especially at the local level.

The ultimate goal is to develop, in Dr. Urquhart's words, "research cultures" driven by a desire to bridge gaps between discovery and application. Doing so requires a combination of "explicit scientific knowledge and local contextual knowledge" and a collective understanding of the "barriers and incentives to achieving changes in practices." These barriers, she says, include attributes of evidence and tools, individual care providers, patients, social contexts, organizational contexts, and political economic contexts (such as funding arrangements and government policies). Closing her remarks, Dr. Urquhart says that developing robust systematic reviews is one approach to knowledge translation because "one study won't change policy. You need to consider larger bodies of literature and worlds of understanding, then integrate them."

At this point, Dr. Hayden and Dr. Urquhart ask if anyone has questions. No one raises a hand, we bid farewell to the team in Halifax and the screen fades to black. Anil then introduces students to a visiting librarian who will teach them how to use MeSH (Medical Subject Headings)[25] and Boolean operators to develop PICO-driven questions and research strategies. Students are subsequently divided into groups and asked to consider strategies for developing PICO questions related to the health benefits of handwashing.

Missed Opportunities

Strolling back to the dorm room I was renting, I pondered the efficacy of this session serving, for many students, as a first encounter with translational medicine, or the concept of translation more broadly. My own background in media studies and information science taught me that learning effective strategies, languages and practices for finding and aggregating information is invaluable to a student's early education in any discipline. I appreciated the narrow focus of the lesson, providing students with a broad definition of knowledge translation and working through a particular component, the development of systematic reviews. Yet, something was missing.

Dr. Hayden and Dr. Urquhart spoke of the "needs/desires" of patients, and framed the difficulty of translating knowledge around barriers generated by social and organizational contexts. Yet, opportunities and challenges implied by the so-called engagement paradigm were never fully explored. There were no concrete examples, no clear indicators pointing to why these concepts and approaches would be important, for

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[25] First introduced in 1960, MeSH was part of a "revolutionary" (Lipscomb 2000) period in medical library science. MeSH was a novel approach to listing medical subject headings introduced by the United States National Library of Medicine (NLM). When it was first introduced, Frank B. Rogers of the NLM noted that MeSH was designed to unify competing schemes for transmitting the "authority" of books and journals relevant to medical science. It was designed with "simplicity for users" in mind, in "requiring familiarity with only a single scheme" (Quoted in Lipscomb 2000). Though out of scope with my present project, one can imagine an even broader expression of the multiple translations at play in translational medicine with a more thorough analysis of foundational contributions of information and library sciences to its contours.

instance, within the unique healthcare contexts of Saint John, Halifax or even the Maritimes more broadly. Students were left with a dry introduction to something that has very significant material, cultural and political consequences. At the same time, there was a baked in and dubious assumption that knowledge pre-exists the practice of translation. Knowledge, in the framework of this lesson, simply lies in databases waiting to be culled and transformed. From an STS perspective, there was no clear sense that, even in the context of "knowledge translation", *new* knowledge claims are also at stake, not just mechanical conversions of existing knowledge into practice.

In discussions with students after class, it was clear that the ambiguous descriptions of systematic reviews and knowledge translation did not really resonate. They did not think the lesson provided a novel or exciting framing of the task ahead of them, as future doctors and researchers who hope to impact the physical, social and economic well-being of Saint John, the province of New Brunswick and beyond. This was, after all, a group of twenty-something medical students learning about databases and search terminology. During the lesson, students yawned and scrolled news blogs, Facebook and Twitter. Few seemed particularly engaged in the material, itself a mark against the "engagement paradigm" set up by Dr. Urquhart. The same is true of Anil, who prefaced the lesson by telling students that he knew "this is going to be boring" and insisted that "they just push ahead and get through it." It all felt somewhat superficial, coming up short of my own expectations for how, and by what means, the concept of translation might be more meaningfully introduced to biomedical labourers in the making.

What I found most confusing was how little the lesson itself reflected the ideal of the engagement paradigm set out by Dr. Urquhart. It was an almost comically clear example of the transfer paradigm, with students passively receiving information from two tenured professors. From my seat in Saint John, the bidirectional displays had the added effect of making students feel especially passive and disconnected. As one student, Shona, put it after class, “I am almost more nervous to speak up and ask questions via that screen system. We almost never have lectures in-person at the Saint John campus.” They added that people in Halifax seemed to have far less trouble asking questions during lessons, and that the in-person presence of instructors and students is likely to be a “noticeably missing piece” of their early medical education.

Similar tensions, of course, exist in STS, between diffusion and engagement models that try to articulate the best ways of communicating knowledge to the public (Stilgoe, et al. 2014). Engagement STS (Sismondo 2008) is especially concerned with how to make sure there is always a sense of co-production between experts and the public. In my mind, this is especially important in the context of medicine, where doctors have to be simultaneously capable of translating their technical knowledge into something accessible to patients and loved ones. Yet, at the same time, better translation to patients would see them empowered to fully articulate the unique social, physical, emotional, cultural and financial factors shaping their experiences of symptoms and their encounters with the medical establishment overall.

The flatness of the overall lesson had me reflecting on my work in Ottawa earlier that summer. I was again confronted with a situation where discourses surrounding translational medicine framed it as simultaneously “necessary” *and* “uninteresting and confusing,” a tension students themselves had been reflecting on through the first couple of months of the school year. The tension is the same one on display in my conversations with Dr. Davis and Karine Morin in Ottawa, where personal and professional goals rub uneasily against problematic separations between distinct domains of scientific and biomedical expertise. Regardless of how superficially they regard translational medicine, no one disagrees with the argument that clinical practices and outcomes should improve better and faster. At DMNB, the burden to make this a reality has been placed on the shoulders of its incoming class of students. One would think that they would benefit from a more compelling argument for how and under what circumstances translation was to be part of this process.

Brand Recognition

I had been warned about some potentially lackluster qualities of RIM just one week prior to Dr. Hayden and Dr. Urquhart's lesson. It was during an interview with a second year DMNB student, "Kevin," who I met at the beautiful Kohns library at UNBSJ. Kevin's tone was gentle, but over the course of our conversation, he offered an intense and nuanced appreciation for the tensions emerging from early attempts to establish DMNB as a site of translational research and training.

Kevin grew up in a small town in Northeastern New Brunswick and recently completed a Master's degree in biology at Acadia University. As part of his degree he produced a longitudinal study of invertebrates, with a focus on population modeling and population change over time. He took three years to get his Master's but submitted his first application to DMNB before completion. This was, as he put it, "a strategic move." He knew there was a good chance he'd need to apply more than once before getting into DMNB, and used the initial application as a learning exercise.

The program at DMNB is four years, with two years of coursework and hands-on training, a year of clerkship and then a residency. Though this is the first year DMNB is doing RIM, and Kevin himself is not required to do research as part of his training, his research background and a number of complaints he's been hearing from friends and colleagues in the first year cohort have him concerned about the goals and overall structure of the program.

In terms of translational medicine and clinician-scientists, Kevin sees a benefit in holding onto divisions between researchers and physicians. "Some students," Kevin says, "simply don't want to do research, and have a hard time understanding why they should be forced to follow through on the research components of this program." For Kevin, the dream of having everyone operate as truly hybrid clinician-scientists is impossible, though he recognizes that anyone who does fall into that category "is going to possess an impressive collection of skills." It comes down to recognizing that "research and family medicine are individually full-time jobs." Kevin is troubled by the fact that new frameworks for medical training are making it "harder and harder to become an MD without a research background. Research is going to be an increasingly important factor for getting better jobs down the line." So, regardless of his and his colleagues' concerns, he knows there is a benefit to RIM because it is "where things are going." Still, he does not think RIM is going to be very successful, at least not for a few years. This is because Saint John is not a recognized research centre and the lab is not yet operational. This makes it much harder for the 30 students admitted to the program annually to be guaranteed the supervision, space and finances required to carry out their four year longitudinal studies.

For Kevin, "RIM doesn't have enough money or resources, so it's going to be five or ten years before it works properly, if ever." He suggests that, for Keith and the other new faculty, there was no incentive to wait this long before spearheading the RIM program. "It will have to, I don't know, remain a bit hollow for quite a while. There is a branding aspect to all of this that I am not sure other students fully appreciate."

Kevin's larger point is not that DMNB, or even RIM, are failing to meet the needs of students, but he sees no point in "sugar coating" the trials and tribulations of simultaneously building a new research space and school of medicine in a town that has never previously been home to them. Overall, Kevin is optimistic, and there are plenty of ways in which he thinks the school does provide a superior education compared to other medical schools in Canada. This is due, in part, to the interactive and collaborative ways in which students are trained. I asked, "do you see translation working in your medical training and practices? Do you see yourself as a translator?" His answer was a definitive "yes," but the examples he provided as support had little to do with keeping up to date with research and more to do with how quickly students are forced to confront the "limits of book learning in practical medicine."

Jack Shit

Kevin was particularly impressed with the patient interviews students begin conducting in the first week of school. These interviews are conducted throughout a student's first two years at DMNB, with emphasis on, in Keith's words, "getting thrown under the bus and realizing you don't know jack shit." Local volunteers and hired actors come in throughout the year to present real and fictional case histories. Often, these interactions are taped so that students and an instructor can review and discuss successes and ways of improving. For Kevin, his earliest interviews were particularly valuable when patients were emotional, or when there were issues of language, gender, race and culture that complicated the process of obtaining personal and family health histories, or of determining in what ways a patient could best be supported.

Kevin suggests other schools do not provide students with what he calls "messy clinical realities" early enough. Students here do patient interviews right away, and do more than "merely shadowing" during their clerkships. This interactivity is crucial, because, as Kevin puts it, "a lot of students will find it uncomfortable the first few times they speak with patients. Waiting until "*it counts* for this practice to enter the training process is dangerous" (emphasis mine). Students learn to embody the patient interview process early on, which over time generates skills for personally assessing their evolving areas of strength and needed improvement. For Kevin, this is where he "feels I am most learning to become a 'translator' or, you know, whatever that means…it means something in these patient interviews."

So, once again, we find a multiplicity in terms of what, when and under which circumstances "translation" is seen as a substantive aspect of research and training practices at DMNB. In my reading, Kevin is suggesting that the labour of translation is enacted at the moment of clinical encounter with patients. It is a flexible, ever-changing aspect of what it means to be a doctor. For Kevin, what is exciting about being thrown into the interview process so early is the fact that "you realize right away that how much you know, how much knowledge of bodies and diseases you have, means nothing. What matters is how you learn to stop and listen to people." It is not that being knowledgeable and well read is unimportant, but Kevin seems to be pointing to a core issue with prioritizing a doctor's expertise over the lived experiences of patients and their loved ones. He sees himself as a "translator" only to the extent that he and his patients can "best work together to find the right answers."

To best articulate the importance of my tracing these tensions between hollow and substantive engagements with translational medicine at DMNB, I need to unpack the critical role played by Dr. Keith Brunt in developing the school and, in the summer and fall of 2013, his soon to be fully operational research lab. A critical missing piece of my story thus far is Keith's own enthusiasm for translational medicine, and his global ambitions for the school, the lab and the biomedical research and innovation culture he wants to "kick off" in Saint John.

CHAPTER THREE:
translation as/and/or commercialization

Driving in his red Ford Mustang to a pub event with graduate students in downtown Saint John, Keith tries to explain his ambitions for RIM. RIM is important because students need to learn to read research regardless of whether they become researchers themselves. Physicians need to be able to keep up on their own terms so they do not, as Keith puts it, "only get their information from their pharma rep." This statement served as a seeming non-sequitur into a discussion of the politics of alumni donations. Keith is committed to giving back to the institutions that trained him but not with equal enthusiasm. He has donated to the University of Saskatchewan library, and has fond memories of his time there. His graduate work at Queen's, however, was a "less than positive experience," at least in terms of the administration and their treatment of his mentor and PI at the lab he was working in. For Keith, Queen's will have to "wait much longer before calculations suggest they deserve a donation."

It quickly becomes clear that RIM and the politics of alumni donations are interconnected in Keith's future ambitions for DMNB, stemming from his excitement that, soon, the first wave of DMNB graduates will enter the job market. He envisions a lecture he will give them about the importance of giving back to the institution that gave them the opportunities and skills to "get good jobs and also professional and social respect." Giving back is a way for the students to recognize "the impact of the institution."

As the site of an unproven medical school and research laboratory, DMNB is populated by students, researchers and administrators whose feet are firmly planted towards an indeterminate future. A student population made up entirely of New

Brunswickians is anxious to see the program gain a national and international reputation in order to guarantee a competitive edge on the job market. An international community of early and mid-career administrators, researchers and postdoctoral fellows have risked job security, and years of research output, to start a new lab and "create a new industry" in Saint John. Navigating the indeterminate future of DMNB's emergent biomedical culture requires everyone to engage, directly or indirectly, with the language and discourses of translational medicine.

The Scrappy Potential

It is 8:00am on a beautiful late August morning. I am waiting for my first in-person meeting with Dr. Keith Brunt. Having spoken two or three times via email and over the phone, it became clear that Keith was always in the midst of a sales pitch. He wanted to sell me on his vision for the school, making "no bones" about it. It was only 20 minutes into our first telephone chat when he suggested that I would "have a hell of a story to tell if" I "played this right." He seemed to be suggesting that we could both benefit from this work, not holding back his interest in a process of mutual back scratching. He was not threatening and did not imply that my access to the school and lab required a particular outcome of my work. Rather, he presented as someone equally driven by research and business ambitions, a hybrid persona he seemed fond of. So, waiting for him to arrive, I was scribbling down a series of "need to have" questions that could reel me in from what I was worried might be an overly scripted introductory tour of the school.

"Mr. Murray?" I hear from behind me. Turning around, I see Keith in a t-shirt, khaki shorts, sunglasses and sandals. He offers me a coffee for which I am groggily grateful. We make idle chit-chat, embracing what Keith calls "the calm before the storm," referring to the upcoming first week of a new school year. We are meeting outside the newly opened DMNB building. As mentioned earlier, DMNB is located on the University of New Brunswick's Saint John (UNBSJ) campus. Keith tells me that they are attempting to foster a tightly knit relationship between the two institutions, but tensions always seem to be bubbling under the surface. There is hope that the almost completed biomedical research facility in the basement of the medical school will be used by instructors, students and researchers from both Dalhousie and UNBSJ.

Our tour begins on the main floor of this surprisingly small medical school. Classrooms, administrative offices, and training facilities are all in close proximity to one another. As described earlier, classrooms and conference rooms have bidirectional screens that connect to Dalhousie's main campus in Halifax. The classrooms mirror those in Halifax, and professors teach simultaneously to students at both locations. Students at each site have special screens and clickers that allow them to ask questions and deliver presentations from their workstations.

Down the hall are a series of training and clinical rooms. One set of rooms is for students to conduct the patient interviews discussed in my conversation with Kevin. Keith is very animated and enthusiastic when describing this area. He is most excited about the blurring of fact and fiction in the case histories provided, as a combination of actual patients and hired actors make up the volunteers. Volunteers come from across the city of Saint John to sit in a mock hospital waiting room and are called in by a student playing the role of a family doctor or general practitioner. Instructors monitor the interviews from an adjoining room. As noted earlier, students do this as of the first week of their medical studies. Keith is emphatic that this is important because it tests against ignorance and "breaks the mold" of having students wait until their third year to meet a “flesh and blood” patient. Pausing, Keith adds that it “more than breaks the mold…it breaks the neophytes down,” referring to the students.

Continuing our walk, Keith stops in an open area with four computer workstations encircled by multiple mock operating rooms. Keith says that Dr. Chris Perry from York University was “floored” by this area’s potential as a clinical research space during summer months, when students have fewer on campus responsibilities. This, Keith says, is his “favourite room.” In part this is because “the scale is so manageable, it makes it possible to do shorter research sprints and have greater impact.” I respond that “I am not entirely sure” what Keith means. He quickly offers that “the goal is to do short, focused, quick turnaround research projects. We want to get in and get out…you know?” Aware that I have also been doing research at UCSF’s Mission Bay campus, Keith offers that his vision “looks a lot different than those sprawling palaces with more money and influence than we have.” He wants to prove that DMNB and his lab can have a global impact with “few people, little starting capital and nothing but good ideas and hard work.” This, it becomes clear in the days and months following, is central to what Keith thinks makes translational medicine such an exciting name, category and set of practices.

Next, I am taken downstairs to see Keith’s lab space, the centrepiece of what he hopes will make DMNB a dynamic translational research and training facility and put Saint John on the global biomedical innovation map. It is clearly a work in progress, full of empty boxes and broken down styrofoam slabs. The equipment, he says, has never been “in action”, an accidental but welcomed riff on Latourian STS. Keith asks me to *imagine* the potential of this space. It might be small, but in the end that could help generate better, more immediate and more novel approaches to translating knowledge.

He is keen about efficiency, flexibility and resourcefulness in the design and organization of these tight quarters. He is also excited about this being a "sustainable" workplace and talks fondly of "multi-taskers," in terms of both the humans and machines he hopes to collaborate with.

Down another flight of stairs is the animal lab, complete with a clean room, a procedure room, a quarantine area, and a place for emergency showers and eye washing. There is also an area intriguingly identified on blueprints as "unexcavated space." We enter the room where animals will be kept and fed. Again, the cages are currently empty, but this room will hold both model rats and mice. They can keep rats and mice in the same room because the smell from these newly designed cages cannot escape. Keith says that mice "lose their shit" when rats are around because of their smell. This is problematic for a number of reasons, most notably the consequences it has for the mice's sexual proclivities.

As we walk out of the animal lab, Keith points across the hall to a room for "computer modeling with $80 000 worth of high-end modeling software." He says very little about the types of work the machines contained in this room will do, but he emphasizes that figure, "*$80 000*," more than once to highlight the cost of running even the smallest research laboratories. For Keith, "knowing the price tag and making the purchases holds me and my coworkers accountable to what we do with these machines. There is real potential in being small, scrappy and dead serious about this place."

We walk back upstairs and into Keith's office for our first sit down interview. The office is located directly across the hall from the main laboratory space and right next to a "multi-purpose" room that Keith says will be used for meetings between on-site researchers, but more importantly with “yet unknown stakeholders who are going to fund our future.”

I am immediately struck by the constellation of human and animal bodies, devices, ideas, dollar figures, disciplines, future orientations, facts and fictions brought to bear on this walking tour of DMNB. For Keith, all of these represent the “complete enterprise of translational medicine.” As someone equally attuned to academic and business ambitions, Keith is sensitive to the same messy networks of agents and agencies traced by historians, sociologists, philosophers and anthropologists of science and medicine. He approaches his work with a commitment to holding himself accountable to the dreams and schemes (Tsing 2005) of entrepreneurial technoscience, all of which inform his particular understanding of and alignment with translational medicine.

“Translation Just Fucking Happens”

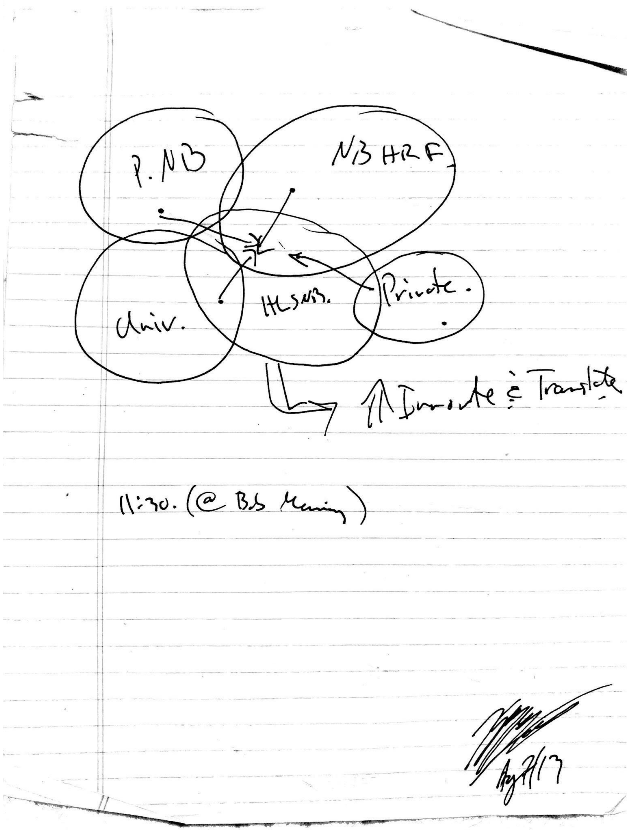
Keith is the first person I meet who enthusiastically self-identifies as a translational researcher. For him, there are at least two kinds of translation at play in his work that he thinks are critical to the emerging research and training culture in Saint John. First and foremost is something I have already introduced: the importance of better facilitating transformations of basic research into improved clinical tools and practices. The second critical category of translational work has to do with converting basic research into sellable products, devices and services. It is with Keith that I am first introduced to an explicit connection between commercialization with what, when, how and under what circumstances biomedical knowledge can and should be translated.

Keith calls this his “two humps model” of translational medicine, and it drives how he imagines the DMNB forging stronger connections with local, regional and national business and community leaders. He recognizes the need for capital investment in the school and research laboratory and sees these as necessary and even enjoyable parts of the work he has to put into “making this place successful.” Keith says that Saint John is “overdue for some good news,” a city on an economic downturn since its heyday as one of the world’s most successful producers of wooden square-rigged sailing vessels in the 18th and 19th centuries (Houston and Smythe 1987; Marquis 2017; Ruff 1982; Wallace 1975).

Keith came here from Saskatchewan and is proud of what he calls his Western Canadian “get it done” attitude. “You have so much potential, you don’t even know” is the message Keith thinks Western Canadians can provide “ these old school New Brunswickians.” “Saskatchewan,” Keith says, “is on the up and up after a major economic crisis, and I’ve tried to become as knowledgeable about common sense business practices as I am about the technical details of my research.” Again, Keith emphasizes his interest in the “entire translational enterprise,” referring to a passion for both knowledge-based and commerce-based translations.

Politically, Keith has an almost libertarian spirit. He champions academic and commercial freedom, and he “would prefer that governments were given less of a say in how” he and his colleagues go about guiding Saint John’s biomedical future. Thinking back to his time out west, he blames a recent downturn in biomedical innovation in Saskatchewan on the inability of the then NDP government to “get with the times” after they “stunted economic growth and lacked emphasis on the right areas of research and development.” At the same time, he thinks New Brunswick’s Conservatives are simply "holding people back" from much the same thing. He suggests that too much interference from governments, regardless of party affiliation, can be bad because if a lab is properly organized, "translation just fucking happens." Following this point, he draws a quick diagram of the "entire translational research enterprise" he is developing, highlighting the Brunt Lab's role as a critical point of contact and service in the process.

The lab is in the center, surrounded by five stakeholder groups: "P.NB" (Province of New Brunswick), "NBHRF" (New Brunswick Health Research Foundation), "HLSNB" (Health+Life Sciences New Brunswick), "Univ" (the Universities) and one simply labeled "Private." The only arrows flowing *out* of this mass of stakeholder groups are coming from HLSNB. These outward flowing arrows are simply labeled "Innovate and Translate."



11:30. (@ B.S Meeting)

Aug 7/13

Figure 2: "Innovate and Translate," by Dr. Keith Brunt, August 7, 2013.

In the summer and fall of 2013, Keith saw himself in the early stages of directing flows of capital, knowledge and influence *into* the DMNB's school and research laboratory. The work they were doing at this point would "set the tone for our status as translational researchers, but we are not yet in the business of translation." For Keith, translational medicine was impossible if one separated the commercial and intellectual viability of research. Good knowledge meant nothing if it couldn't be converted, via people and profits, into "things that immediately help patients." The benefits of these conversions needed to be felt in individual patients, but Keith wanted to make clear early on that his ambitions far exceeded making New Brunswick physically healthier.

As I began to meet Keith's colleagues in academia and business in Saint John, I wanted to trace whether his understanding of translational medicine was somewhat universal, or at least common and accepted among his colleagues in New Brunswick. Was his definition something that unified the diverse goals of the people who have either recently moved to Saint John or recently become affiliated with the Brunt Lab from UNBSJ science faculties? As I continued my fieldwork it became clear that none of the faculty, students or administrators had anything resembling a unified definition of translational medicine and how it might contribute to their professional success or the broader success of the school and research laboratory.

No unified definition, but there were a number of subtle connections that, if parsed carefully, might explain how translation is being mobilized at DMNB. The discourse around efficiency and expediency, for instance, always seemed to exist uneasily alongside a desire to bring together a wide range of stakeholders, specialist languages, and types of expertise in encounters between different "knowledge users." As Dr. Urquhart suggested in the introductory lesson detailed above, a key element of biomedical translation is the strategic customization of messages to specific audiences. This was a thread I could follow between the definitions and descriptions of translational medicine offered by students, researchers, medical doctors and administrators at DMNB.

Divisions of Discourse and Labour

As the site of an unproven medical school and research laboratory, DMNB is populated by students, researchers and administrators whose feet are firmly planted towards an indeterminate future. A student population made up entirely of New Brunswickers is anxious to see the program gain a national and international reputation in order to guarantee a competitive edge on the job market. An international community of early and mid-career administrators, researchers and postdoctoral fellows have risked job security, and years of research output, to start a new lab and "create a new industry" in Saint John. Navigating the indeterminate future of DMNB's emergent biomedical culture requires everyone to engage, directly or indirectly, with the language of translational medicine. This includes multiple points of view and nuances of exploring the social and economic potential of translational medicine. The wide and varied definitions and descriptions provided in what follows serve as a foundation on which I can describe, critique and, ultimately, intervene in the deliberative potential of translational medicine.

At DMNB, operating as a new medical school and a yet to be fully operational biomedical research lab, the novelty of the work they are doing is just as important as their ability to choose the right framing concept for purposes of promotion, branding, and investment in raising their profile. Keith was specifically recruited by Dr. Anthony

Reiman, the Assistant Dean of Research at DMNB, and others to be the one to get the research lab off the ground. Thomas and Petra, a husband and wife team of cardiovascular and diabetes researchers came later, along with Anil. In describing their recruitment, Dr. Reiman emphasizes the need for a robust division of labour in translational medicine, even if aspects like commercialization are not directly tied to his own work or his understanding of translational medicine:

> **R:** We had to sort of try to view them with the frontier spirit that they needed to have to help us start a brand new program and do some things they might not have been asked to do in a more established program, and they've been willing to do that. So, Thomas especially has stepped up and has taken on a lot of the administrative responsibility to get the lab up and running. Petra is going to kinda shepherd our local graduate students. Keith is sort of our commercialization guy, he's just, he's into that, and he's working with some of the local community leaders interested in seeing that happen.....As for the commercialization piece, I mean, it's...we all just sort of recognize that an important part of university-based research is the potential for intellectual property, we need to protect that, and the consequent potential for commercializable ideas to get commercialized. The University of New Brunswick and Dalhousie both have machinery for commercialization, technology transfer and all that stuff. And, you know, there are a lot of elements to that. There's how you work with an existing industry versus how you start a new industry. All that is just stuff we're learning as we go and bringing whatever experience those of us who have done this have to bear on it.
>
> **C:** Is this something you just have to accept as part of the game when you get to a certain scale?
>
> **R:** Well, I think...you know, regardless of embracing it, some people aren't interested in it and regard it as something they don't want to get involved in and any pressure they feel to get involved in it they just find distasteful. But I personally think it's good for academia to engage with industry or create new industry. I think there are just different points of view on this...a lot of nuances.

Thomas and Petra

Keith's colleagues Thomas and Petra, a husband-and wife-team hired in tandem in 2012, are much more excited about on-the-ground research than commercial pursuits. Thomas is from Bombay, India and completed a Bachelor's of Pharmacy degree in 1998 before spending a year working as a “scientific officer” responsible for screening cardioprotective drugs at Piramal Healthcare in Mumbai. Thomas then completed his doctoral training at the University of British Columbia (UBC). Following his work at UBC he pursued a three-year postdoctoral fellowship at Harvard. For the next four years Thomas worked as a senior research fellow at the University of Alberta, studying metabolic aspects of obesity, insulin resistance and diabetes induced cardiovascular disease and its complications.

Thomas and Petra met at Harvard in 2007 while she was working as a visiting scientist at Beth Israel Deaconess Medical Center. Originally from Austria, Petra completed her master’s and doctoral work at the University of Graz under the supervision of Dr. Rudolf Zechner. In 2009, a year after Thomas began his senior research fellowship, Petra began a postdoctoral fellowship at the University of Alberta in a laboratory run by Dr. Jason Dyck. Her current research focuses on the molecular mechanics of metabolic disorders, specifically those related to lipid metabolism and signaling in the development of obesity and diabetes-related comorbidities.

Thomas and Petra were brought on as key members of the team charged with building the research laboratory and recruiting the first wave of doctoral and postdoctoral researchers at DMNB. Their focus is research and both are hesitant to concern themselves with issues of commercialization and what they call “public relations”. Neither seems particularly engaged with translational medicine but they align themselves with it as a strategic label. Petra was especially clear when articulating her disinterest in the concept and practice of translational medicine while acknowledging that it played a significant role in garnering support for her work.

C: So, what does translational medicine mean to you? Does it make any

> difference in your day to day work?
>
> **P:** Ha. Ummm, I don't know. I hate the concept of translational medicine, but I have to use it politically. I do the work I do to eventually help people, but translational medicine makes it difficult for some researchers to get funding. If you can't prove that your work is both helpful to people and profitable they won't fund you. Every North American grant application, and a lot of companies, want us to translate, but I don't know what that means.
>
> **C:** Is it just strategic then? Do you identify your works as translational in order to fulfill your goals? It helps your reputation and DMNB?
>
> **P:** I guess so, yeah. It is the word we have to use. For me, the school and the lab to make it we need capital investment, government funding and community networking to build up over the next 10 years. It is the only way for us to become self-sufficient and to get the right reputation.

For Thomas and Petra, translational medicine is associated with a particular strategy for obtaining funding for themselves and for the lab in general. It is more a branding or marketing strategy than a concrete approach to multidisciplinary research collaborations. At the same time, it is specifically identified as a way of articulating the commercial viability of their research. It seems to operate as a framing device, something that reminds them that, for the time being, they have to engage with public and private funders at both provincial and federal levels *and* seek to network with local community leaders. Like Keith, Petra and Thomas' references to "community leaders" seem always to refer to business leaders and city councilors, not necessarily patients or members of various non-expert publics that make up Saint John's population. This is related to the fact that their work is future oriented. They hope to build the "foundations" on which the school and the lab can become self-sufficient and reputable, which means that their so-called "community" needs to be made up of those with the power, influence and experience to get them there.

Of course, both Thomas and Petra are sacrificing quite a lot by helping to design a new research space instead of spending what they call their "mid-career" years at well established and reputable institutions. The allure, they suggest, has something to do with the eventual "catching up" they will be able to do at DMNB when they finally start working with real students and postdoctoral fellows. At Harvard or the University of Alberta, had they pursued tenured positions at these institutions, they might have "three or four students or research assistants. Here, maybe we could work with twelve, and then those twelve students will author and co-author papers that will improve everyone's resumes." This will help Thomas, Petra and Keith make up for the lost time they have suffered "building a lab from scratch."

Anil

Translational medicine operating as a branding strategy came up a few times in my conversations with DMNB's researchers and administrators, especially in an early interview with Anil. Anil had just begun his new position as the JD Irving Research Chair in Occupational Medicine at DMNB when I arrived in the summer of 2013. He had moved from his home in England where he spent nine years working as a lecturer in respiratory medicine, an occupational health consultant and the deputy chief medical officer at the University of Sheffield. He continues to work as a clinical lecturer at the University of Manchester, a position he has held for more than twenty years.

For Anil, providing an answer to the question "what is translational medicine?" had as much to do with strategic engagement with possible funders as it did with something he believes truly informs his daily research and teaching practices:

A: Looking at categories, there are things I do that I never would have realized

> was translational research. Increasingly, it is probably going to be helpful to brand myself as a translational researcher…because it's of the moment, and those are the words that people are expecting to see.
>
> **C:** Outside of it just being a branding or a strategic sort of label to give to your research, is there anything particularly new in your mind about what translational research, or that category, is trying to do?
>
> **A:** Categorizing it helps focus on what you are trying to do and, to that extent, the fact that it's got a category and a definition to it probably helps explain to other people some of what you're trying to do. So I think that categorization, classification, in that way, is helpful….I guess it's a bit like the difference between saying I'm a biologist or a molecular biologist.

For Anil, translation as a general category or classification is productive because it helps focus not just his own practices but also those of the other researchers, patients and funders that will be implicated in his work on occupational toxicology and "workplace causes" of respiratory disease and skin disease. Yet it is also a personal branding mechanism, something that identifies him to potential public and private investors and supporters as being "of the moment" and meeting their expectations of the "words they expect to see."

Anil sees his work as an occupational physician, concerned with better understanding the effects of "arts and trades" on human health, as a perfect example of an area of research that requires more efficient and expedient translations between labs, clinics and workplaces. He also describes how his work "as a translator" is clearly visible in his contributions to the 11th edition of the World Health Organization's (WHO) *International Classification of Disease* (ICD-11). As part of an international consortium of researchers, government officials and members of diverse publics, Anil is working to define "diseases of occupation" and new ways of determining whether individuals are "fit to work" in different fields and geopolitical contexts. Ultimately, the ICD-11 will be used as an "eHealth record to better facilitate patient-doctor interactions around the world." Though he thinks that translational medicine is sometimes an "overused and inadequately defined concept," Anil ultimately sees some value in embracing it as part of his professional identity.

Dr. Reiman

Dr. Reiman responded to my questions about translational medicine with a detailed overview of the potential hazards of it meaning so many things to so many people:

> **C:** What sort of relationship have you had with translation as a category of research and do you have any thoughts on it as a category? What has been your encounter with translational research?
>
> **R:** Well, I think the term means different things to different people...it's used for the purpose the user intends. So, I don't know if there is a universally accepted definition of translational research, and I think that translational research and knowledge translation are not necessarily the same thing in everybody's mind. So, my first exposure to the term was to understand it as the type of research that, in my little world anyway, links the lab to the clinic. So, it's translating discoveries or understanding the biological basis of disease into better management of the disease in the clinical setting or vice versa, taking that clinically recognized problem and going back to the lab to try to understand the problem better in order to better manage it. So, that's the way that I initially was using the term in my little world doing that type of research. It seemed like if that was the way you used the term then people would understand what you meant and didn't think of it as anything else. But, as I've gone along I've realized that there's other ways people apply the term. Translational research can also expand the gap between research and practice, so, as you say, knowledge translation...how you take information you gained from research and apply it to improve health hookups, for example, is another way the term can be used. I think it's become even more liberally used to mean just about any kind of research that bridges any kind of gap you can come up with. So, I think the term, perhaps, has less utility than I thought it did. Either the term has less utility than it used to or that I just didn't understand it.
>
> **C:** For some the big concern is how much of the emphasis is on commercialization, translating a gap between research and commercial applications.
>
> **R:** Oh yeah, that's an important point, but it gets confusing when people end up on either extreme end of what commercialization means. Some demonize it

> outright, others champion it too heartily. It's a messy thing, but not an inherently good or evil thing.
>
> **C:** One of the things I'm interested in here as the research lab gets set up and connections between the university, the college, the hospital and the hopes of getting some capital into the research lab, is that question of the commercialization of research, both the necessity of it but also some of the problems that can arise from an over focus on having big pharmaceutical and biotechnology companies involved in research....Here, because there is a lot of speculation of what can happen, I am wondering about what possible futures might be on the horizon for biomedical research in Saint John.
>
> **R:** Ha! I mean, yeah, I wish I knew where we were going to land on that front, but I think we have a thoughtful division of approaches between Keith, Thomas, Petra, Anil and the incoming researchers and post-docs, that we can balance the need for good work and the need to pay the bills. Time will tell.

Dr. Reiman's concerns with "liberal" uses of translation pertaining to more than just his "little world" sparked for him some anxiety about the value of the concept going forward. He seemed genuinely thrown off by its inclusivity, assuming that a broad and unclearly defined concept was of less "utility" than one that attempts to bridge very specific gaps between research labs and doctor's offices.

Old Wine in New Bottles

The wide and varied embrace of translational medicine lamented by Dr. Reiman informs more general debates about the conceptual efficacy and novelty of translational medicine. Citing an over-reliance on the rhetoric of innovation and commercialization (Littman et al. 2007; Wehling 2008) some have dismissed current understandings of translational medicine as rhetorical catchalls, slight rewordings of what entrepreneurial scientists have aspired towards since the mid-twentieth century: the application and mobilization of novel research in clinically and commercially viable ways as quickly and as cleanly as possible. Historian Duncan Wilson puts it this way, "[w]hile the term emerged in the 1990s many argue that Translational Medicine's core aim and methods are longstanding and that it represents little more than 'old wine in new bottles'" (2015, para. 1).

There is some substance to these concerns. In his 1945 report to President Roosevelt recommending plans for how to support postwar science and medicine, Vannevar Bush emphasized the importance of multidisciplinary teams of stakeholders responsible for advances in cancer diagnosis, diabetes management and the improved life expectancy of the American population. According to Bush, these advancements were achieved through a linear movement from:

> ...a great amount of basic research in medicine and the preclinical sciences, and by the dissemination of this new scientific knowledge through the physicians and medical services and public health agencies of the country. In this cooperative endeavor the pharmaceutical industry has played an important role, especially during the war. All of the medical and public health groups share credit for these achievements; they form interdependent members of a team (Bush 1945, 12).

The war was such a productive time for biomedical advances because, in Bush's words, there was a "large backlog of scientific data accumulated through basic research in many scientific fields in the years before the war" (1945: 12). In Bush's framework, basic research was "scientific capital" and applied research was designed to identify the practical transformations of basic research. "The scientist doing basic research" may not have any interest in practical outcomes but the "further progress of industrial development would eventually stagnate if basic scientific research were long neglected" (Bush 1945: 18). Bush emphasized a system where basic researchers were left to their own devices and made only cursory mentions of there being particular mechanisms by which others might be trained to interpret and apply that research:

> Discoveries pertinent to medical progress have often come from remote and unexpected sources, and it is certain that this will be true in the future. It is

> wholly probable that progress in the treatment of cardiovascular disease, renal disease, cancer, and similar refractory diseases will be made as the result of fundamental discoveries in subjects unrelated to those diseases, and perhaps entirely unexpected by the investigator. Further progress requires that the entire front of medicine and the underlying sciences of chemistry, physics, anatomy, biochemistry, physiology, pharmacology, bacteriology, pathology, parasitology, etc., be broadly developed (Bush 1945, 14).

Bush's framework downplayed private investment in research, championing government support and, most importantly, university education and research where the "individual worker" would have the "opportunity for free, untrammeled study of nature, in the directions and by the methods suggested by his interests, curiosity, and imagination" (1945, 13). The key was that basic science was to be kept free "from the influence of pressure groups, from the necessity of producing immediate practical results" (Starr 1982, 342). This freedom, alongside increased specialization in the fields and subfields of the biological sciences, generated some genuine frustrations among clinical researchers and medical doctors hoping to see expedited benefits from the increased growth of the NIH budget, which ballooned from "$4 million in 1947 to $100 million in 1957 to $1 billion in 1974" (Briggle 2012, 32).

There was a growing assumption that basic research of potential relevance to healthcare and medicine was distinct from basic science in physics and other domains. By the late 1960s, researchers began describing increasingly troubling gaps between basic research and clinical settings, where scientific findings were supposed to be transformed into useful diagnostic tools and treatments for diseases ("Phagocytes" 1968). In a 1974 article for the *New England Journal of Medicine,* Steven Wolf argued that this gap was the result of a "partitioning of the activities and interests of investigators together with a rapid proliferation of specialty meetings and journals, a lack of understanding of the new knowledge and the failure to appreciate its broad implication" (802). The implication was that a new link, one much stronger than the one outlined by Bush, bringing together basic and clinical sciences, was needed in the interest of efficiently and expediently getting practical applications into the hands of doctors and clinical researchers.

By the mid-1990s and early 2000s, researchers came to a troubling finding, a widely reported *17 year* time lag from the time a basic discovery is made to the time of conversion into a drug, practice, or treatment option (Balas & Bohen 2000; Morris et al. 2011). At the same time, the years since *Science: The Endless Frontier* had given rise to increasingly corporate universities (Cheyfitz 2009) and government funding models emphasizing the importance of economic viability as much as the scientific validity of proposed projects. More effectively integrating these already blending domains seems, if nothing else, the ultimate goal of translational research initiatives, especially the last two decades of NIH and CIHR strategic roadmapping efforts.[26] In both the United States and Canada, the desire to lean into the murkiness of hybrid public-private initiatives is only getting stronger.[27]

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[26] Beginning in 2002 and 2003, the NIH began a process of, what they called, "roadmapping" strategic priorities for improving biomedical research outcomes. The NIH were imagining a better future in which the distance between what they called "the bench and the bedside" could be traversed more expediently and efficiently. The NIH Roadmap identified three themes that needed to be addressed to make these dreams a reality: 1. New pathways to discovery; 2. Research teams of the future; 3. Re-engineering the clinical research enterprise. The Roadmap was designed to help researchers overcome perceived "gaps" "blocking the transformation of discoveries in the life sciences into improvements in health" (van der Laan and Boenink 2015). The NIH was not developing a strategy specific to any one institution, biomedical subfield or research project. Their vision of translational medicine was supposed to simultaneously connect all of the national institutes under an umbrella initiative while allowing them to maintain their political, social and ethical independence. At the same time, researchers were encouraged to simultaneously network with private industry and public advocacy groups. This suggests an embrace of the necessity of corporate support while remaining sensitive to the wishes and needs of patients and their communities.

[27] In 2009, funding support for social studies of health and illness in Canada shifted from the Social Science and Humanities Research Council (SSHRC) to the Canadian Institutes of Health Research (CIHR) (Albert 2014). This was part of CIHR's recently announced Health Research Roadmap, subtitled "Creating innovative research for better Health and better health care." The Roadmap was initially designed as part of a five year strategic plan to align the CIHR's research support practices with the Canadian government's priorities in improving health and health care while also improving Canada's global reputation for biomedical innovation. CIHR's strategic plan emphasized "building research excellence, translating knowledge into practical applications and deepening the pool of highly skilled individuals" (CIHR "Strategic Plan 2009-2014"). Katelin Albert has argued that CIHR's Roadmap is not particularly unique, and Albert, Laberge, and Hodges (2009) have suggested that the initiative was directly inspired by the NIH's 2004 Roadmap. The initial CIHR Roadmap laid out plans from 2009-2014, which the CIHR divided into four "strategic directions": 1. Invest in world-class research excellence; 2. Address health and health systems research priorities; 3. Accelerate the capture of health and economic benefits of health research; 4. Achieve organizational excellence, foster ethics and demonstrate impact.

Still, there have long been major concerns that translational medicine has been designed to “re-direct funds and sources from other disciplines without providing any true conceptual novelty” (Littman et al. 2007, 1). The question of novelty in terms of specific areas of research might be less important than addressing the need for “several stakeholders to join forces under a unified concept aimed at identifying ways to better translate basic biomedical achievements into practical benefit” (Littman et al. 2007, 2).

As a site of translational research and training, DMNB is stuck between two ways of appreciating the messiness of translation. They could choose one unified definition, sure, but how would that work? It seems that different points of view and their attendant nuances are worth holding onto, for instance, in Dr. Reiman’s understanding of translational medicine, described above. Finding commercialization distasteful is not going to make it go away, but with the right division of labour perhaps something of a balance between the social and economic viability of particular projects and initiatives might be reached, at least in his framing.

For DMNB, “creating a new industry” in Saint John requires a complex combination of personal and collective ambitions of students, researchers, and administrators. Without the stability that comes from being a long reputable site of biomedical research and training, everyone at DMNB is perpetually looking “down the line,” “learning as they go,” “finding their legs” and trying to develop strategies for success on “unproven ground.” It might not always be clear what it is, but there exists an assumed necessity in engaging, at least superficially, with translational medicine as something that will help students, researchers and administrators meet their hopes and expectations for the future.

What I was left with, however, was not an overwhelming concern with the diversity of understandings of translational medicine or that it might be too open-ended, capable of “bridging any gaps” I could think of. Rather, I became concerned with the *lack* of openness that was beginning to reveal itself. Definitions and descriptions of translational medicine all seemed to suggest that, in some way, there was an important role for local communities to play in determining what research should be translated. In class, students learned that patient needs and desires are core elements of evidence based practice. They also learned that these patients are “knowledge users” and “decision-makers,” major component parts of the collaborative processes by which research is translated into novel products, practices and therapies. However, I began to wonder what role patients and other community members were really going to play in the early stages of developing a research and training culture founded on the principles of translational medicine at DMNB.

What Community? Whose Community?

For Keith, a huge part of his job is exploring how best to engage the local community, as a means for drumming up support for his goals as a translational researcher. Community outreach is, however, limited to navigating how to gain the attention of local business leaders, journalists and city councilors. And it is clear that there was no consultation with the diverse non-expert publics that make up Saint John’s population. Like my colleagues in critical disability studies, and those tracking activist movements in a range of biomedical contexts, Keith is one of many proponents of translational medicine driven by direct and indirect forms of paternalism (Carney et al. 2021; Foley

2017). Experts, for some, need to run free so they can discover, translate and impose their knowledge on the bodies and minds of existing and potential non-expert patients.

The very notion of a "pure" and unfettered understanding of basic research, as outlined by Vannevar Bush in the mid-twentieth century, necessarily implies that there is no immediate need to move basic research into clinical settings more expediently. Rather, the assumption was that, eventually, with the archive of basic research made available, some individual or institution would do something useful with it. Yet, the mid-twentieth century also represented a period where scientific institutions were increasingly being asked to justify their existence, including increased demands for meaningful applications of science for both society and industrial stakeholders (Nye 2011). Not to mention emerging patronage models that had scientists, at least gently, guided by the hands of those willing to finance their work (Solovey 2015). The fact is, "pure" research never existed in the first place, something Mary-Jo Nye (2011) points out was being expressed by Michael Polanyi and a wide range of others, Ludwik Fleck, Robert K. Merton and Karl Mannheim among them. These, it is worth noting, all represent philosophers of science who provided some of the early foundations for what became STS and its offspring.

Translational medicine is distinct because, in some of its guises, it specifically outlines the need for the public to actively engage in negotiating its contours. Yet, even for a site as localized and "small" scale as DMNB, relevant members of the local "community" referred mostly to wealth managers, political influencers and business leaders. They want to brand, promote, raise their profile, and then begin the process of doing actual research. Rather than a critique, this is just one example of the way things are in North American translational medicine, especially in an era of intensifying neoliberal political and economic motivations (Birch 2016). Yet, if we accept that translational medicine is, for the time being, here to stay, the most immediately productive question is not “is translational medicine conceptually novel?” but “how can non-expert publics be more adequately engaged in shaping a more inclusive understanding of translational medicine?”

At DMNB, the need to build practical benefits was universally framed around the need for “community outreach” where what Dr. Reiman above called “a lot of nuances” could be managed by first and foremost making decisions based on the needs of local communities. Yet, no one seemed particularly interested in a broad and inclusive definition of community. DMNB’s ambitions wind up looking more like those of one of my other field sites, the University of California San Francisco. The nuances at hand seem to leave out those diverse publics that continue to be implicated in discussions of translational medicine, but not in any particularly active sense.

Big Things Coming

Keith takes a sharp turn down the hill leading from the UNBSJ campus to Saint John’s uptown core, insisting that “this is how I’d drive even if we weren’t running so late.” He begins to tell me about the history of the HLSNB, about the desire to turn Saint John into a start-up hub. “Just wait until you meet Bob, we’ve got big things coming.”

It’s 11:30am and we are on our way to a meeting with Bob Manning, a wealth manager and the chairman of HLSNB, in downtown Saint John. Keith describes Manning as the most important community member his lab needs to impress. He likens the HLSNB to a burgeoning MaRS Discovery District, the controversial public-private innovation hub located near the University of Toronto’s St. George campus. Keith has been slowly working to get HLSNB on board with his lab in order to facilitate the “final acts of innovating and translating knowledge” when the lab is fully functional and his next wave of research projects are fully underway. This knowledge, hope against hope, is to be translated into the economic and bodily health of Saint John and eventually lead to DMNB developing its own “innovation park” with a global reputation for cutting edge research. “They haven’t cut a check yet, but they will,” Keith says, fully embracing his “get it done” attitude.

We’re in an empty parking garage in the city’s uptown core. My feet buzz as they hit the ground after the rocky and whirling trek from DMNB. The HLSNB is located in an office building very close to the site of Saint John’s shipbuilding heyday. The area is now much more geared towards tourism, with brewpubs, shopping complexes and a museum, whose current exhibitions highlight both the city’s shipbuilding past and its role as a key site of conflict during the War of 1812.

We walk through the parking garage and head up the elevator. The doors open to a modest hallway, down which we stroll through a wooden door with a small name plate indicating that this is the HLSNB headquarters. The office is unassuming, with a modest reception desk at the front and two or three small rooms in the back. As we enter the furthest room to the back, Keith points out that he is excited that I am with him on this trip. “Bob is gonna love it,” he says, “you’re proof enough that people are talking about us.”

Bob is a slight man, with glasses and a standard issue grey business suit. He seems animated, but also no nonsense, a man who knows what he is trying to build and why. He begins by describing the need to kickstart economic development in the city, noting that a 100 years of “nothing to speak of” has caused severe bodily and economic health problems in the community. “I let Keith be the medicine guy, but I’ve been here all my life, and it’s hard to see anything getting any better without bringing in some new blood. Keith’s good for that too,” referring to Petra, Thomas and Anil, as well as a wave of postdoctoral students who will be joining them from around the world in the coming years.

Bob presents an overview of his “strategic vision” for developing a larger research and innovation culture in Saint John specifically geared towards local health and wellness concerns. I ask whether and how those concerns are determined. He says, “well there are lots of data sets that tell us what we need to know, and we need to effectively translate, or transform, the population data into amazing new ideas and technologies that change the course of this city’s future.” “Okay,” I say, “but how do you know who to reach out to, who in the city gets to sit in the chair I’m in right now?” Bob seemed satisfied by the fact that he has relationships with local business and government leaders, especially with large corporate families like the Irvings, the family of oil magnates whose name spreads through every park, statue and public space in the city, not to mention the chair in occupational medicine at DMNB that pays for Anil’s salary and research endeavours.

The conversation quickly moves to translation itself, as I ask Bob if it means anything to him and what role it plays in his business strategies. Bob says that it is “kind of always on” his mind, in part because he knows that it is the biggest hurdle for the kinds of start-ups he wants to bring to the city. “If we want to be the next San Francisco, we need to always have a clear and present idea for how to get from funding to research to commercial product or service.” For Bob, the key to translation is the unidirectional linear movement of ideas through a simple to understand, but hard to successfully traverse, production line. This, of course, is a common understanding of technoscientific innovation since at least *The Endless Frontier*. I ask Bob why a clear and sellable idea is so critical, and he quickly replies, “If the idea, and the pitch, aren’t sound, we’re never going to get ourselves over the valley of death.”

The Missing Masses

The people I met in Saint John were not inherently ignorant, greedy or closed-minded. They all spoke with a depth of purpose and passion, and stated sincere desires to help people in Saint John and beyond. Their discourses, however, revealed the ways in which publics, even through the best intentions, can sometimes be cut out of our models of technoscientific innovation. For some reason, wanting to operate at the cutting edge makes it harder to take seriously how those without perceived power or expertise might be brought in to make meaningful contributions to determining what can or should be translated. The oft-cited question that seems most relevant here is Latour’s “where are the missing masses”? Though speaking of mass in a much different context, Latour’s 1992 paper has inspired a wide range of politically minded STS and STS affiliated scholars to question how and in what ways citizens and publics of all shapes and sizes fit into political, economic and innovation discourses and practices. Shiju Sam Varughese has proposed that the age of technoscience presents us with three categories of publics: “…*scientific-citizen publics* constituted by civil society, *quasi-publics* that initiate another kind of engagement through the activation of ‘political society,’ and *non-publics* cast outside these spheres of engagement” (2012, 239; emphasis in original). For Varughese, these categories are only palatable if we take non-Western technoscientific contexts seriously, an argument I whole-heartedly disagree with. Their view of what constitutes “civil society” assumes that Western democracies are in fact democratic. With that said, I do believe that there is value in the three categories of publics Varughese lays out. Talking with Keith and Bob, along with their colleagues and students at DMNB, it is clear that there are a vast number of non-publics, whose bodies and lives are at stake in the developing research culture in Saint John. The problem is that no one seems to be concerned with how their individual and collective lived experiences might serve as the foundation on which the contours of translational medicine might be shaped. They are raw research material or afterthoughts, a point evidenced by the inability for many to think about relevant “communities” without casting them aside in advance. Rather than an indictment of specific people I interviewed for this project, I find this to be a much more common and cumbersome problem to overcome. It is also something that revealed itself with increased subtlety and complexity as I found myself further and further confronted with what Bob called the “valley of death” in Saint John and San Francisco.

punctum 1:
wandering the biomedical valley of death

Keith and I are walking, Tim Horton’s coffees in hand, through the halls of DMNB in November 2013. He is talking more about his ambition to develop a “mini-MaRS” innovation park on campus. DMNB and the new lab space are just “first steps” toward this goal. We walk to the back of the building and out a heavy glass door. Keith turns to the right and points out the UNBSJ’s school of nursing in the neighbouring building. We stroll down a flight of concrete stairs and onto a sidewalk. Striding by the nursing school I peer into a window and see a large mock hospital room with a naked mannequin haphazardly thrown on a bed.

Continuing our stroll, I notice that the medical and nursing schools are atop a hill across from the Saint John Regional Hospital, with buildings tall enough that their highest floors are at our eye level. We descend down another set of stairs and into the parking lot separating the hospital from the schools. The lot is full of cars carrying doctors, nurses, administrators, technicians, patients and loved ones, entangled in messy amalgams of care. Keith turns to me, points toward the expansive cement pad flooded with automobiles and says, “there’s your valley of death.”

Figure 3: "The Biomedical Valley of Death," from November, 2013. Photo by Author.

Waking a Sleeping Metaphor

The valley of death is a cornerstone metaphor in the domains of innovation, venture capital and technology transfer. It refers to perceived gaps between basic and applied research, or between laboratories and marketplaces (Auerswald & Branscomb 2003; Marham et al. 2010; Hudson and Khzaragui 2013). The valley of death might be considered a "tired" (Harris, Meyer and Leith 2013) or "sleeping" (Martin 1991) metaphor, one so common in discussions of technoscientific innovation that troubling implications generated by its biomedical uses get lost. In translational medicine, the valley of death has been appropriated to describe perceived gaps between basic bioscientific discovery and the development of clinical and commercial applications.

I argue that the metaphor has been reinvigorated, or woken up, in biomedicine. This is because the biomedical valley of death does not and cannot refer just to figurative deaths of start-up companies, or failures of venture capitalists and angel financiers to transform basic research into commercially successful products. The biomedical valley of death is also populated by the physiologically dead and dying bodies of model organisms, research participants and patients, including those for whom new means, modes and methods of diagnosing and treating disease will never be translated quickly enough.

When Keith casually referred to the parking lot as “the valley of death” I was taken aback. It struck me (pricked me) as a perfect encapsulation of my work so far. His use of the valley of death metaphor was a telling example of tensions between superficial and substantive engagements with translational medicine that informed my research in the summer and autumn of 2013. He seemed fully aware of the embodied, literal deaths implied in the metaphor, but was only interested in telling me about his and his institution’s large-scale plans for becoming global leaders in biomedical innovation. Indeed, the dreams and schemes (Tsing 2005) of DMNB’s model of translational medicine were laid bare in that parking lot. In the days and weeks that followed, every trip I made between DMNB and the hospital involved a pause in the midst of the cars and moving bodies as I tried to take in the mundane panorama of what goes into and out of making biomedical worlds and futures.

There was something profound in subtly shifting my focus from frustrations with a lack of unity in the definitions and practices of translational medicine to an emphasis on the embodied implications of its discourses. The parking lot was a powerful reminder of the concrete and physiological consequences of names, categories and practices. Indeed, there were serious consequences embedded in even the most hollow uses of the valley of death metaphor. These spoke to the need for a richer appreciation of what translation can be and should be, especially in terms of the messy politics of cross-cultural engagement and collaboration (Hsieh 2020; Spivak 2004). In a certain sense, the parking lot rearranged the possible geographies laid out in Keith's sketch of the "translational medicine enterprise" in Saint John. How might that sketch look if the parking lot was embraced as both physically and figuratively at the centre? What might happen if entanglements of social, cultural, political and physical bodies of patients/participants, clinician-scientists, administrators, staff and others *was* the "full" enterprise of translational medicine in Saint John? Rather than a transient space to overcome and avoid, might the biomedical valley of death be reframed as a literal and figurative site of sustained cross-cultural collaboration? The parking lot became, for me, a concrete heterotopic (Foucault 1986) reminder that traversing risky terrain is not a momentary phase in a unidirectional technoscientific journey. It is an ongoing multidirectional flow that makes the indeterminacy of biomedical futures impossible to overcome (Meskus and Oikkonen 2020). So, I chose to stay with the valley of death metaphor, to situate it historically and politically.

History of the Valley of Death Metaphor

Despite its wide and persistent use, the history of the valley of death metaphor in biomedicine has received little attention. Those who have tried to place it historically slip too quickly into assumptions that the valley of death is a real and traceable obstacle that innovators *must* overcome when commercializing new inventions (Gulbrandsen 2009; Markham et al. 2010; Midler 2019; Ellwood, Williams and Egan 2020). The metaphor needs a more nuanced analysis to simultaneously tease out material and semiotic associations that have, in part, made it such a long-standing rhetorical device. Again, the problem for me lies in Keith's unreflective use of the valley of death metaphor, and in its use in translational medicine more broadly. Uninterrogated, the metaphor points to a narrow understanding of what biomedical translation can and should be. This is important not only because the valley of death has been described and rendered so frequently in popular and academic publications. As the narrative punctum above suggests, some proponents of translational research take the valley of death very seriously, associating it literally and figuratively with perceived gaps between their work, economic prosperity and the future health of patients, research participants and the communities in which they live (Armstrong et al. 2020; Gamo et al. 2017). However, the seriousness attached to the metaphor has a lot more to do with the health and wellbeing of commercial and research enterprises than human bodies. This is due to an unreflective appropriation of the valley of death metaphor from contexts where the stakes are less directly life and death.

Though it is not easy to pinpoint its first usage in discourses of technoscientific innovation, some argue that the valley of death metaphor was coined in 1995 by Bruce Merrifield. Merrifield used the metaphor as a way of describing challenges getting farming innovations taken up in developing countries (Markham et al. 2010: 404). Since then, the metaphor has been widely used in popular and academic writing about technology transfer (Gulbrandsen 2009; Takata et al. 2020), management (Abereijo 2015; Midler 2019), innovation (Dean, Xiang and Zhao 2020) and venture capital (Savaneviciene, Venckuviene and Girdauskiene 2015). In all of these domains, the valley of death suggests that the process of transforming basic discoveries into commercially successful innovations is a “life-threatening” journey through a highly competitive technoscientific landscape (Gulbrandsen 2009). As John Weyant has argued, the metaphor is designed to remind innovators that “many, if not most, ideas developed in research laboratories fail to make it all the way to the marketplace” (2010: 674). The valley of death refers to a period of uncertainty and complexity (Dean, Xiang and Zhao 2020) when a new start-up must deal with increasing debt, develop detailed risk-benefit analyses, and search for funders ("angel financiers" and venture capitalists) that will help them get their product into the hands of users and consumers (Auerswald & Branscomb 2003).

The challenges identified with the biomedical valley of death look much the same as those outlined above. However, in translational medicine, the multiplicity of spaces, bodies, technologies and domains of expertise required to transform research into new products and practices invites questions concerning where, when and how the valley of death is reached during the innovation process. The answer is, unsurprisingly, that there has never been a single valley of death in translational medicine (Gohar et al. 2018). Proponents have pointed out valleys of death between research findings and clinical practice (Parrish et al. 2019), between pre-clinical and clinical research (Seyhan 2019), between clinical research and the marketplace (Gamo et al. 2017), and between "discovery" and "policy" (Meslin, Blasimme and Cambon-Thomsen 2013). Each valley represents a gap in funding, knowledge, influence and power that keeps "good ideas" from being used in the diagnosis and treatment of human disease.

These multiple valleys of death account for what Keith calls "the entire enterprise" of translational medicine. His framing of a "two humps" model of translational medicine is, in his words:

> ...meant to highlight two critical valleys of death, but they are not the only two. They are, for me, the most important because they reflect whether your research is strong and whether you know how to tell the world about what, when, why and how this work is so valuable. (From Field Notes, January 2014).

As always for Keith, the sales pitch is a critical piece but only if there is substantive *value* and *strength* embedded in the research being done. As a result, he thinks there is "a unique life and death component to the work" he does that distinguishes it from other domains of technoscientific innovation. Which, again, suggests that he knows there is something literal in his use of the valley of death metaphor, even if he seems flippant about it.

It is, of course, safe to say that biomedicine is uniquely about life and death without ignoring the ways in which other domains of innovation are themselves risk-rich mortal enterprises. Still, Keith tends to fall short of fully accounting for the implications of his use of the valley of death metaphor. Keith is a sincere, hard-working physician and researcher, and clearly wants to help people; I do not doubt this for a second. His prioritization of capital and expertise are not inherently wrong-headed paths, but they are indicative of a fairly narrow view of who and what matters in the translation of biological knowledge. This lack of reflective engagement comes up in a lot of framings of translational medicine. There is sometimes a comical mashing together of so many mixed metaphors that opportunities for fully accounting for the stakes of biomedical innovation are missed.[28]

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[28] Mixed metaphors abound in descriptions of translational medicine. A shorthand for translational medicine is "bench-to-bedside" research, indicating that the goal is the movement of novel discoveries into clinical practices, therapeutics, drugs and diagnostic tools (Gohar et al. 2018; Goldblatt and Lee 2010; Kreeger 2003). Getting from the bench to the bedside as quickly and efficiently as possible requires, according to a 2009 U.S. NIH roadmap, new ways of thinking about the "entire enterprise" of biomedical research. As Michael Kleinman and James Mold have pointed out, one of the major products of the roadmapping project was the "reconceptualization of a Research Pipeline connecting basic research to practice" (2009, 312). The "pipeline" they outline involves two types of research, basic and human, and "translation is required to connect each to the other and to practice, and the process is, in theory at least, bidirectional" (Kleinman and Mold 2009, 312). Movement within the pipeline is meant to help researchers push knowledge through two distinct "roadblocks." The first roadblock involves the translation of novel understandings of disease mechanisms into "the development of new methods for diagnosis, therapy, and prevention, and their first testing in humans" (Sung et al. 2003, quoted in Rabkin 2015: 1). The second roadblock lies between "the translation of results from clinical studies into everyday clinical practice and health decision making" (Rabkin 2015, 1). These two distinct roadblocks are described as "valleys of death" that are being "negotiated" by biomedical practitioners interested in commercial rather than just practice and decision-making outcomes.

Biomedical Valleys of Death

The valley of death is variously described as a “phase,” “obstacle,” or “threat” that needs to be “bridged” (Gulbrandson 2009), “crossed” (Butler 2008), “traversed” (Coller and Callif 2009), “driven across” (Wessner 2005), “leapt or soared over” (Derda et al. 2015). As noted above, the bidirectionality of movement across the valley of death is often only theoretical. Many still adhere to language and discourses that frame this as a unidirectionally linear process, one that can be developed into a digestible and reproducible model (Ellwood, Williams and Egan 2020).

STS is, of course, rich with critiques of models and metaphors of speed and antagonism (Burke 2016; de la Bellacasa 2015; Haraway 1997; Heide 2010; Martin 1991, 1992;). Echoing what Maria Puig de la Bellacasa has argued–in a paper on the disconnect between the temporality of soil and the temporality of technoscientific discourses and practices–the pace required for the patients and publics meant to benefit from biomedical translations is often “at odds with the predominant temporal orientation of technoscientific intervention, which is driven by an inherently progressivist, productionist and restless mode of futurity” (2015, 1). Regardless of any stated interest in holistic, collaborative and multidirectional models of translational medicine, its spatial and temporal orientations always seem tied to fast, unidirectional and expert-driven designs and practices. The valley of death metaphor proves this as well as anything else.

The more I walked across and between the DMNB and the hospital via the parking lot, the more I became concerned with the concrete qualities of the valley of death metaphor implied but never fully embraced in its use in biomedical contexts. Granted, the model emerging at DMNB may or may not be typical. Even from my perch, refining this dissertation in 2022, it is still too early to tell what constitutes a “typical” model of translational medicine, or whether a typical model would even be possible or useful. Still, I became fascinated with how much Keith’s understanding of the valley of death matched those in popular and academic renderings, with people/patients showing up in two places: 1.) Literally and metaphorically dead, lying in deserted expanses between basic discovery and applied products and practices, something almost nobody talks about explicitly; 2.) Safely on the other side, the end of the journey, reaping the rewards of successful translation.

It seemed so obvious that, beyond failures to develop new products and practices, there were sick and dying people for whom this metaphor was, well, not really a metaphor. Image after image in popular and academic publications seemed to miss the uncomfortable disconnect between stated goals and depictions of what the valley of death looked and felt like. I became increasingly fascinated by a question concerning where, exactly, the biomedical valley of death was, where it should be, and how we might better prepare everyone involved, especially patients, for the journey.

Where is the Valley of Death?

The geographic origin of the valley of death metaphor has been variously linked to Death Valley in Nevada (Auerswald and Branscomb 2003), the Valley of Kidron, often cited as the “valley of the shadow of death” referenced in English translations of Psalm 23:4 (Haupt 1919; Weyant 2010), and the Valley of Balaclava, site of one of the most embarrassing battles of the Crimean War (Hargadon 2010). The cultural significance of each of these valleys reveals some interesting differences in how the valley of death metaphor has been deployed.

The most common and direct association is Death Valley in Nevada. As some innovation scholars have suggested, the “imagery of the Valley of Death (which connotes Death Valley in Nevada, USA) suggests a barren territory” (Auerswald and Branscomb 2003: 230). Critics of the metaphor argue that the valley of death implies a landscape of scientific and technological innovation made up of “nothing more than science and users of science, separated by a desolate wasteland” (Harris, Meyer and Leith 2013).

A similarly messy mix of desolate wastelands and problem-solving strategies are at play in the biomedical valley of death. Researchers are perceived to be on one end of a vast gap, with clinicians and patients on the other. The assumption is that the space between is dangerous, partly due to its inefficiency and partly to its capacity to leave even the best conceived research in the dust. Much of the discourse around the biomedical valley of death implies that the best bet is to bridge the valley, to avoid it, or at least pass over and through it as quickly and efficiently as possible. Failure to do so means death to whatever start-up was banking on the profitability of a given research endeavour. It also implies death for patients to whom the products and practices of that research will never reach. Yet, the assumed flow is from experts to non-experts, and the journey is often framed as a singular event. As Keith noted earlier, if we let the process unfold “naturally” then “translation just fucking happens.” The implication is that the journey across, at least for an individual piece of bioscientific knowledge, is a one time thing.

Visual renderings of the biomedical valley of death often make explicit the life and death stakes, in the form of bed-ridden research participants and patients, or cartoon skeletons and tombstones. However, these images are never really *about* flesh and blood bodies. There is an additional and baffling metaphoric layer applied to the biomedical valley of death, where the death of patients and research participants is but a stand-in for the loss of funds, profits and prestige. The skulls and bones at stake are rendered mythic and figurative, attached to corporate rather than corporeal bodies. This is both funny and infuriating because, taken more literally, the weight and stakes of the biomedical valley of death could be made far more immediate.[29]

Looking back on my research in the midst of the COVID-19 lockdown only adds further weight to the matters of care (de la Bellacasa 2017) and concern at stake with the biomedical valley of death. Across the globe, debates about whether to support workers or corporations has made clear how both are equally seen as lives worth saving. Risk assessments have reinvigorated perceptions that the collective health of global corporations is as, if not more, important than the health and safety of human bodies. Both are persons, but not the same kind of person (Ripkin 2009; Plitt, Savjani and Eagleman 2015).

It is this tension that I think reveals the real danger of unreflective uses of the valley of death metaphor in translational medicine. It is, often cheekily, used to emphasize the personhood of start-ups as they embark on a treacherous journey of self-actualization. Profitability and global economic impact are at least as important as the potential for traceable outcomes in the form of healthier bodies and improved clinical practices. It reads like a fairly obvious, if dissonant, correlation between corporate and human persons. And this is precisely why so many people feel

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[29] This is especially troubling as I work through final dissertation edits in the spring of 2022, with North America looking bleary eyed through pandemic goggles. COVID-19 has only made more apparent the weight and anxiety afforded to corporate interests and innovation strategies. The speed with which design and management consulting firms have built new frameworks for "innovating in a crisis," as McKinsey & Company recently put it, makes clear that we are stuck in a world where money-cum-lifeblood is given more political, social and economic weight than the physiological health and wellbeing of human persons. Perhaps we should start embracing a more literal interpretation of legal frameworks that suggest that "corporations are people," considering the layers of care and concern we have for their health and well-being.[#] As Melinda Cooper (2011) has argued, these stakes can be articulated in terms of the ways neoliberalism reworks how life is valued, including how the lives of patients and research participants are embedded in the messy politics of late capitalism.

comfortable dismissing translational medicine as nothing more than a rearticulation of linear models of commercialization. I argue, however, that not only is the valley of death metaphor a rich foundation on which to critique translational medicine's discourses, it is also a fantastic platform on which to dig deeper into the potentiality (Friese 2012) of translational medicine to become a rich and truly "new" (Robinson 2020) framework for collaborative cross-cultural biomedicine.

Making the Lab "Real"

I am once again crossing the parking lot from the hospital to the DMNB building, on my way to the official opening and ribbon cutting ceremony for the Brunt Research Lab in late October 2013. I am returning from a tour of some rooms in the basement of the hospital where Keith and colleagues are hoping to secure additional research space. The tour guide, Tony, one of the hospital staff, is quick to point out that these research facilities will be "right next to where we keep the bodies, the dead bodies, before they go out to funeral homes and all that." This spatial proximity has not driven Keith to choose this available space over others. It is, in fact, "the only other space on this whole campus where we might expand before we have to build something new." Still, as I make my way to the ribbon cutting, I can't help but awkwardly smile at the unique symbolism at play in just the possibility that Keith's team could be doing translational research so close to the embodied stakes of their work. Everything here is still so speculative, in the making. It is funny to feel in the midst of a staggered future, coming from a completely unsecured space in the hospital to a space not yet put to use as a hub of translational research at the main DMNB building.

It is only fitting that I bump into Petra and Thomas parking their Subaru. As they emerge from their vehicle, I see they are both dressed up and looking mildly uncomfortable in anticipation of the opening. This is going to be, in Petra's words, "a nice end to one part of the journey, but barely the beginning of the real work I came here to do." The event is important, but the only evidence they offer for this fact is that the lab opening is going to be attended by members of the local media, city and provincial political figures, business leaders, DMNB students and administrators, nursing school students, and a range of clinician-scientists from the nearby hospital. These people, Keith will later tell the assembled group, represent "the community who made this possible, and who are going to make the lab real."

I separate from the clinician-scientists so they can prepare for the ceremony and walk into the DMNB building alone. A woman at the main reception counter asks me who I am. I introduce myself and she mentions hearing that I've "been floating around the campus." I am one of two anthropologists she's met in her life and she expresses fascination with the kinds of questions and "ways of thinking" we bring to biomedical contexts. She then directs me to Hippocrates, referring to a bust of the famous proto-physician, suggesting that it will be a "prime" location from which to take in the event. There is rich symbolism in being situated next to this bust, a shared sense of the importance of "doing no harm" between doctors and anthropologists, two domains of expertise that have had to accept and learn from violent colonial pasts.

In front of the bust is a podium, and to the side there stands a Dalhousie Medicine promotional poster. There are pitchers of water and sad looking trays of vegetables and fruits that nobody touches. Local and provincial politicians, researchers, physicians, journalists, donors and administrators begin to pour in. Some wear lab coats symbolically, some wear them because they are in the middle of a shift at the hospital. Dr. Anthony Reiman is first to speak. He expresses excitement about the new research lab and reminds the group of the exciting opportunities this new space is going to generate for researchers and the community.

Dr. Reiman introduces Bob Manning, who speaks about his “overwhelming excitement” that this long journey is over. He remembers a moment in 2009 when the first contract for the new medical school was being drawn up. Salaries for four scientists had been allotted, but no space for them to conduct research. One man slammed his hand on the table suggesting that this was outrageous. The “campaign” to get the lab built began in earnest after that. This heroic narrative concludes with Bob asking those four salaried scientists to identify themselves. Keith, Anil, Thomas and Petra all raise their hands and the hallway erupts in applause.

Next to speak is a member of the Irving family, the oil and manufacturing magnates that have long dominated the economic, social, cultural and political lives of New Brunswickers. She is here to talk about the immediate goals for Anil’s role as a translational researcher in occupational medicine. His chair position has been named after and paid in full by the Irving family, who hope his work will immediately help the “chronically ill workers” who produce their vast wealth. She speaks fondly of something called Molly’s Drive, a grassroots campaign for funding biomedical research in Halifax. It began with a housekeeper who provided $5 to an employer who was donating money to fund cancer research. Her point is that “the smallest steps have the highest impact.”

Next, Keith, Petra and Thomas give brief remarks before cutting a large ribbon hanging across the threshold of their new lab. It becomes clear that the ribbon cutting is not for these researchers, and especially not for the people for whom their work might one day benefit. It is for Bob Manning, the Irving Family, the administrators of the school and for the benefit of current, but more importantly, prospective students and researchers. This is a promotional event, a pat on the back. It is an image attached to a 150 word write up in the local newspaper. It is the perceived end of one journey and the beginning of another.

It becomes clear to me that the major issue I've had with my work in Saint John is that everyone seems stuck inside linear narrative frameworks for imagining the future of biomedical research and training. They know, deep down, that the reality of the school and research lab is much messier, or at least say that they do, but they can't help but see everything through a lens of progress. Each step is but one more checkpoint on the road to success.

Counterpoints: Living Inside the Valley of Death

As we embark on a group tour of the lab space, I try to network with my fellow travelers. My group is led by Thomas, and I am with Bob, the woman from the Irving family and Dr. Duncan Webster, a clinician-scientist working at DMNB and the hospital. The tour seems like a fitting context for making connections, since Thomas is emphasizing the collaborative spirit of translational research. This, he offers, directly informed the "design of this small space full of so much promise." He echoes Keith's excitement about the fact that they have purposefully chosen "devices and graduate researchers that are multitaskers," a hook that seems to resonate with everyone. It is also in the spirit of translational research's collaborative multitasking that I plan to reach out to potential interlocutors.[30]

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[30] Most notably, I was hoping to secure an interview with the Irving family, to better understand how and why they chose to fund Anil's occupational research Chair, and how they understand the goals of this new lab's translational research foundations. It is

As the tour proceeds, Dr. Webster asks how I was finding my time in Saint John. I offered that it had been great so far, but I was still trying to "find my sea legs" in terms of the research. I then admitted that he had been on my radar since I first connected with Keith in the spring of 2013. In fact, there had not been a single student, researcher, physician, administrator or support staff person who failed to mention that Dr. Webster's work, character and background embodied the *true* spirit of translational research. "Well," he replies, "I've been hearing a lot about you from Keith and a couple of my students as well. We should probably hang out."

Two hours after the ribbon cutting, I am once again crossing the parking lot from DMNB to the Saint John Regional Hospital to meet with Dr. Webster. Reaching the main hospital entrance, I get into an elevator that takes me to the 22nd floor. Walking slowly from the elevator doors to our meeting room, I look out the window, across to the main floor of the DMNB. A look down immediately reveals the full expanse of the parking lot. The cars are much smaller, the people mere specks of faded colour darting this way and that. I have arrived first, in an unadorned and unoccupied meeting room near Dr. Webster's office that "only gets used for brief breaks between meetings, rounds and research scrums." He comes in a few minutes later, pats my shoulder, insists that I call him "Duncan" and emphasizes how exciting it was to be "cold called" by an anthropologist interested in his work.

Like Keith, Duncan is a self identified translational researcher, but one whose whole approach, or "enterprise," is vastly different from his colleagues. Duncan is a

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made immediately clear that there will be no interview. She offered that the family likes their "work to speak for itself." The implication was that my role was confusing and unimportant. She refused an interview not out of fear that I'd blow any doors wide open, but because I provide too small a platform to justify taking any communication risks.

philosophy major turned medical doctor and clinical researcher, a background that he believes directly impacts his approach to translational research:

> DW: Certainly it influences my ability to work and communicate with other people…there's a whole lot of different ways to look at this world. I always kind of begin with “where are you coming from? What are your, you know, initial axioms that you have to build your world around you?” when I work with patients or research collaborators. So, my approach might be my way but someone else's approach may seem very different but is certainly just as valid. So, you know, I think I'm able to be open-minded and see where people are really coming from.

Duncan traces the origins of his open-mindedness to a somewhat “scattered” approach to undergraduate studies. He completed a B.Sc. in chemistry and physics, but also pursued a second degree in the philosophy of religion. After undergrad, he completed a Master’s in philosophy. Philosophy of mind was his area of focus, with his thesis providing a refutation of John Searle’s concept of consciousness.

> DW: A materialist account of our minds makes no sense. To start with *objects*, that’s silly. We should start from subjectivity, our distorted minds, and you might be able to get to a place somewhat resembling objectivity.
>
> CM: It is funny you say it in those terms, since debates around the partiality and situatedness of knowledge is pretty fundamental to the kinds of work people in my field produce. There are people, especially Donna Haraway, for whom embracing the modesty and partiality of our positions as knowing subjects is a liberating foundation on which to build a new kind of objectivity.
>
> DW: Yeah, I love stuff like that. Like I said, I have my way of knowing the world and you have yours. It seems pretty silly to assume one matters more than another. Haha. I get the sense this is why folks suggested you talk to me. I can get lost in this kind of conversation.
>
> CM: That is part of it, but first and foremost people have kind of framed you as the poster boy for “real” translational research at DMNB, especially your work with Chris Gray.
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> DW: Poster boy. Sure. I mean, yeah, the anti-TB [Tuberculosis] work certainly checks off a lot of the right boxes for folks around here.

Keith, Tamara and Chris Gray, Duncan's chemist collaborator on an anti-TB treatment, have all singled him out as the best all around example of the translational medicine ideal. For Keith, Duncan's research "hits the right notes" in the sense that the work is challenging and substantive but also has a sellable narrative attached to it, one that Duncan is extremely sensitive about. Duncan is less immediately interested in getting over the commercialization hump in his work, preferring to stay more closely tied to the richness of cross-cultural engagement required to ethically translate.

Duncan has been working with chemists and the Eskasoni First Nation in Cape Breton to test whether a traditional tea, made of cow parsnip, might lead to novel therapeutics for the global fight against Tuberculosis (TB), a disease that still impacts around a quarter of the global population (CDC 2018). His interest in this area stems from a combination of his philosophy training and his broader interest in how different cultures understand health and healing.

> DW: I have always been struck by the fact that different cultures approach medicine in different ways. I had some intercultural experiences before medical school. When I got into medicine, I was thinking about things along those lines. There are lots of ways to approach medicine, so why does work over here unfold one way, and over there a completely different set of principles are at work?
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> CM: When and how did this interest start shaping your medical research?
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> DW: Like, right away. I was only a resident when I got fully invested in First Nations health, working with different communities and elders. I was struck by a lot of the different approaches to medicine. Their philosophy, the medicine wheel, and their approach to health being shaped by philosophies much different than my own. And also the herbal medicines, which led directly into the work with Chris Gray.
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> CM: How did the TB research come about? When did you begin to actually work with an Indigenous community?
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> DW: It's kind of a cool story. I was an internal medicine resident out in Calgary and was beginning to pursue infectious disease research as an area of

> specialization. I traveled up to visit the Eskasoni, which is a First Nations community in Cape Breton. I heard about this woman Sara Denning, one of the elders, who did a lot of traditional medicines, you know, with plants.
>
> CM: How did you hear about her?
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> DW: I don’t actually remember. It came up as a completely random thing. Which, I love…just being open to the possibilities. So, when I got up to Eskasoni…there's a lot of neat things about the journey up, but anyway I did ultimately find her house, you know, just sort of found my way and knocked on her door and she opened the door, she happened to be at home, which was all part of the grand plan (laughs).
>
> CM: Wait, you just showed up uninvited?
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> DW: Not exactly. Some members of the community knew I might come for a visit, and pointed her house out to me. No one seemed to think it would be a bad idea to knock on the door, so I just did it. Anyways, she invited me in and as we got talking I noticed she had on her stove this pot, this pot with some water simmering, and there was a root sitting in the pot. She told me about this plant, which is cow parsnip. She gave me some of this tea and we chatted about a whole variety of things, including the use of this tea as a general tonic for respiratory ailments, and she pointed out its use in TB treatment.

Duncan was given some of the cow parsnip along with very rough instructions for reproducing the tea he shared with Sara. He was excited, and decided to see if he could isolate some elements of the cow parsnip, to offer some scientific backing for its use in infectious disease treatment. He was wondering exactly what it was the Eskasoni had tapped into that convinced them the tea was “working.” His research mentors encouraged him to test the extent to which the cow parsnip produced a clear immune response.

> DW: So we worked with some immunologists at Dalhousie and produced an aqueous extract, which was essentially boiled root and tested it against myriad microphages. We were trying to see if it would stimulate the release of interleukin 6, which is a general marker of immunostimulation. And it did. The higher the

> concentration, the more interleukin 6 it released. So there was this dose response curve, which was really neat.

Subsequent to his initial trip to Cape Breton and collaboration with immunologists in Halifax, Duncan presented his findings to a group at the University of Alberta. A colleague who witnessed this presentation, who happened to be working with anti-TB compounds, suggested they test the cow parsnip extract against his assays. The goal was to see the extent to which they could "scientifically validate the compound's traditional usage."

> DW: When we did, it had really powerful TB activity. It might be surprising, but when you read the literature there is often a really good correlation between traditional practices and what you see in the lab. When you take traditional medicines and you run them in the lab, to see if they've got activity for the sort of use they're espoused for, in fact there's really good correlation for the traditional use with the activity that's found in the lab, which stands to reason because these cultures have been doing, you know, their own sort of randomized controlled trials for generations, right, so things have been figured out and sorted through.

Duncan seemed immediately aware of the troubling ethical questions that arise from trying to scientifically validate traditional knowledge. This, for him, was directly tied to his somewhat accidental introduction to translational medicine as a concept and set of practices. He was simultaneously sensitive and realistic, in terms of understanding the need, at least for some audiences, to validate at microscopic levels the "action" of the cow parsnip on TB. Yet, at the same time, the rest of our conversation pointed to a sincere awareness that a continuing back and forth collaboration with the Eskasoni was the only way to "translate thoughtfully, ethically."

> CM: Wow, so this does seem like a fairly exciting storyline for promoting the power of translational medicine. What was your first encounter with this notion of translational research, or knowledge translation, and what kind of relationship do you have with it now?

> DW: Yeah, well, you know, it actually wasn't a term that I had heard until I went to present this research at the University of Alberta. I'm sure it was floating around but I didn't really pay attention. Umm, but when I presented these findings, as a first year internal medicine resident, I actually got an award for translational research.
>
> CM: (laughs) Oh, really? Like, you were given an award for an approach you didn't realize you had taken?
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> DW: Yeah, so I was like,"oh,well that's kind of neat." But, I mean, it made perfect sense. What was kind of neat about this was not only was it going from the bench to the bedside, ultimately, but more this was actually going from the bedside or the community to the bench. So, there's that full circle there.
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> CM: So, as someone who identifies more explicitly with translational medicine now, how has the project evolved along those lines?
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> DW: Well, the next phases of translation are all over the map. After presenting that research, sure we had a sense that there was an immune response, but that doesn't really tell us much in terms of developing a treatment. The next step is, you've got this root, but what is the active component? So, that is where Chris Gray comes in.

For Duncan, "thoughtful and ethical" translational research is an inherently multidirectional and cross-cultural practice, not something so directly connected to the efficient and expedient conversion of knowledge into products. In 2013, Duncan was ahead of the curve, espousing an approach to translational research and ethics that has only more recently entered the zeitgeist. As Hostiuc et al. put it, more recent debates about translational medicine have emphasized that there is a "cultural" and "moral" dimension to translation that needs to be taken seriously:

> The ethics of translational research should go beyond the classical topic of research ethics, or medical ethics. It should not only analyse the ethical issues that can be directly derived from the translational phases but also those derived from the gaps between translational phases, transfer of knowledge and the particularities of translational research per se (2016).

Duncan takes these ethical dimensions almost for granted, much like Keith takes for granted the need for capital investment and a solid sales pitch to shape DMNB's future global reputation.

Translating Chemistry, Culture, and Commerce

I met Chris Gray the day before my conversation with Duncan, in his office in the UNBSJ's science building. Chris is a UNBSJ chemistry professor and researcher, with a particular affinity for working with natural products. Though he has been at the UNBSJ since 2007, the period in 2010 when Duncan first approached found Chris in a precarious position when it came to active research. This was due in part to the lack of lab space and resources at the small university, something he was told was "soon to change" with the DMNB and Brunt Research Lab. In the meantime, he was young and ambitious, having recently moved to Saint John from South Africa to "kick start" his career. He needed to get something published sooner than later. That's when Duncan came knocking. As Chris put it, "Duncan needed a chemist. I was a chemist needing stuff to work on."

Chris has always been passionate about endophytes, microscopic organisms like fungi and various bacteria generated within living plant cells. For Chris, endophytes were one way for him to work within the world of ethnopharmacology, which he describes as "an all around fascinating area of research." Like Duncan, Chris emphasizes the importance of learning to work together without dismissing different ways of knowing the world. It is "the only way to work across disciplines, but more importantly across cultures." At the current stage in their collaboration, both Duncan and Chris see Chris as the "driving force":

> CG: I've become the driving force for the project now. Primarily it is natural products based from here on out. You can only go so far saying 'this extract is active…you really need to know what compound in there is doing the activity. My role would be to take crude extract, purify it, isolate the compound and work out what the molecular structure is.
>
> CM: But how does that affect the truth claims about how the cow parsnip works in the original tea? Would your truth about the inner workings of that molecular structure mean anything?
>
> CG: Yeah, I mean, I think about that all the time. We're in this modern world, where we know if a drug works and why it works. It's this particular molecular thing and it is having this particular effect on this enzyme. I can see how that might be difficult for somebody from a First Nations community. How do you link that molecular thing to holistic spiritual beliefs about the natural world?

What becomes clear is that both Duncan and Chris are aware of the fine line they need to walk between scientific validation and outright dismissing Eskasoni explanations for what is at work in the cow parsnip tea. They do not pretend there is any way out of this tension, but at least do some leg work to acknowledge that a molecular compound and Sara Denning's tea are not the same thing.

> CG: The fact that they are boiling these roots for hours on end, it could be 'steam and humidity' that is creating the effect. It is not outrageous to think that the holistic process of producing the tea is core to how it works. So, I have to hold back my immediate urge to assume there are microscopic entities, like antibiotics, doing all the work. It is a helpful way to broaden my and my students' understanding of what constitutes the effects of natural products.
>
> CM: I guess the question is how much value can you see in trying to isolate the molecular compound while adequately championing traditional healing practices. Like, how can you do both at the same time?
>
> CG: I'm not sure how many young First Nations people are interested in this traditional healing stuff. We're losing an opportunity to connect with older healers who might have knowledge we haven't yet tapped into. There is this discrepancy. If we can show that there is a scientific basis for traditional healing,

> and the older way of looking at it, we might find a healthy integration between multiple ways of knowing how stuff works.

Chris and Duncan have no delusions about the possibility of seamless integration, and are especially sensitive to the challenge they'd face adequately crediting the Eskasoni traditional healing practices if their work produced a global TB treatment.

> DW: A really critical issue is the long history of Eurocentric interests mining their community for answers then walking away. We don't want that to be the case. When I returned to the Maritimes, before proceeding with my work with Chris Gray I tracked down Joel Denning, Sara's son. Sara herself had passed away. I told Joel, "TB is a global issue, especially for marginalized groups. One of the big issues is drug resistance, yet your community has a traditional solution that might solve that. I don't want to be disrespectful, but what we can do is keep researching, using your extract and searching for the active molecules."

This is, for Duncan, the foundation on which he sees himself as "truly" committed to a translational approach to medicine. He doesn't see his work with Sara Denning, her son and the broader Eskasoni First Nation as a casual or curiosity-driven thing. He wants to harness multiple perspectives to help solve a global healthcare crisis. TB is, after all, a disease that is agnostic of the cultural nuances at play in different approaches to eradicating it.

It is here where we return to the valley of death metaphor. For Duncan, translational medicine is unique in that it is purpose-driven. This is why he thinks people so quickly mistake it for a unidirectionally linear process. Yet, for him, taking this extract and one day developing a drug is not the end of a linear journey of progress.

> DW: With medical research it is critical to think about where you want to get to. Sure, curiosity can drive people, but ultimately it is about coming back to patients…to people. Because I am a clinician, I have the luxury or benefit of seeing patients, which has to directly relate to my research. There are many interesting things I'd have fun studying, but not if I can't see a pathway to helping

> people. You're trying to get back to the bedside. You're not problem solving for the sake of problem solving. In that sense, translational research is really critical.
>
> CM: In terms of the TB research, can this be translated into a drug that a large pharmaceutical company would want?
>
> DW: Yeah, you know…yes. But, it's funny, because of my philosophy background and who I worked with in my training. One of my mentors in medical school had a very big anti-Big Pharma perspective, and that was really driven into those of us who worked with them. At heart, I'm a left-wing pinko! The ideals of capitalism don't appeal to me. But, I eventually realized that I could be an idealist but never get anything done. That's a problem I've had living in this world.
>
> CM: This isn't a local health issue, since the treatment for TB would have global reach. Is that it, the scale of pharmaceutical companies, just makes that the only way to navigate the next steps?
>
> DW: Exactly, the next steps are way bigger than me, and go beyond what I'd be interested in. There's a point where I don't own this work, but the question is how to remain committed to the traditional places where the knowledge comes from.
>
> CM: It's interesting to think about those contrasts in terms of how the actual cow parsnip itself changes between the two domains, between the lab and Sara's kitchen. It takes on a different character, scale and materiality.
>
> DW: You're absolutely right…what I've experienced in the Aboriginal community, the approach is much more spiritual…to take it down, break it down to the molecules that are active, I think a lot would say "that's not how it works". That plant is a whole, and when you're pulling a piece out…it's put together that way for a reason.

For both Duncan and Chris, developing an anti-TB treatment is not an endpoint, but the foundation on which to build a new model of long-term cross-cultural partnership with Indigenous healing philosophies and practices. As Chris points out, "the likelihood of us isolating a wonder drug for TB is low, not to mention way way way down the line." This changes the contours of their purpose-driven approach to translational medicine:

> CG: We're just scratching the surface…the next step is making stronger links with First Nations. It is going to be quite the challenge…But, we don't have to start off big. That's one thing our group has shown…we punch above our weight as far as research goes. The equipment we've got and the funding we've got, we've achieved quite a lot with very little. We know we can do this from a reasonable scale and with reasonable goals. Yet, we're in an odd situation. Ethically, Duncan, myself and our Indigenous collaborators feel like we're often on the same page.
>
> CM: In what ways? Where do goals and needs overlap?
>
> CG: Anything that comes from this…we want the recognition to go to the First Nations communities first. Without their partnership, however, we won't be able to help them.
>
> CM: What do you mean "help them"?
>
> CG: Help them in the sense that we want to help them improve their conditions, we want them to have access to new ways of benefiting from their knowledge, but we need to find ways to dig beyond what is already available. You know, it is actually kind of hard to imagine giving monetary benefits given that we're currently using knowledge long in the public domain in a sense. What we want is to find out what we don't know…which means very serious collaborations going forward. I'd prefer to have those partners in place before I begin to imagine what the ultimate goals of that work are.

Despite vagueness in the details Chris provides, it is clear that he is at least somewhat aware of his problematic role and the extent to which he is just there to "validate" traditional beliefs and then move on to the next stage. The process of translational research becomes much messier and more multidirectional out of necessity.

> CG: You've got to be careful about the words you use. Validating the medicinal use of plants is pretty important if you want to make something that can be accepted globally as a treatment. But, validating isn't even the right word. We are really just offering another way to define the evidence. Yet, the isolated compounds don't replace, in fact they provide a rationale for, the need to preserve the traditional knowledge that exists. Again, a lot of it isn't written down…so how can we best save it, share it and do something with it?

Duncan himself suggests that the goal is to “stay in the middle of things” and to never forget the social and cultural dimensions of health that, for him, are what make working with Indigenous communities necessary and necessarily messy, imperfect and violent:

> DW: The original impetus for me to get interested in this as a student was a Royal Commission report on Indigenous health. Half the committee that produced the report was First Nations. When they looked at the problems, the root cause was the loss of culture, self esteem and heritage. How can we fix this? Health and culture are intertwined. The solution is not for white doctors to come in and say “look, this is what you need.” The approach is, let’s revitalize communities from within. I see looking at traditional medicines as a chance to take part in that. I wanna say, “look, you guys have used this for generations. It’s not lost knowledge, but a lot of people don’t know about it. I used to make the mistake of saying that I was ‘validating’ traditional knowledge in the lab. That’s obviously the wrong way to frame it…it is just another way of knowing.

The valley of death metaphor, with its connotations of war, competition and commercialization doesn’t account for the unique goals and practices of researchers like Duncan and Chris. Indeed, a number of self-identified translators of medicine, including Duncan, see commercialization as a necessary, but peripheral goal. Duncan’s openness to multiple perspectives, and his willingness to collaborate both within and outside the confines of academic medicine, highlight the potential benefit of new ways of articulating the processes by which medical knowledge is translated between disciplines, bodies, scales, communities and technologies.

Valleys of Death as Gathering Places

In 2013, Duncan and Chris’s work was unfolding at a time when a unique approach to integrative research was becoming increasingly popular in Canada. In 2012, the CIHR and the Institute for Aboriginal People’s Health (IAPH) announced a joint initiative to fund research based on a “two-eyed seeing” model of Aboriginal health. Two-eyed seeing is meant to emphasize the value of research with one eye on the benefits of Western technoscientific medicine and the other on the benefits of traditional health and healing philosophies and practices. For many, this model is meant to overcome a “helicopter” approach to collaborations with Indigenous communities, where researchers enter a community, extract data and then rarely return (Hall et al. 2015; Peltier 2018; Smylie et al. 2004). Two-eyed seeing is about sustained effort and long-term partnership with more than simply profits and products as end goals.

Walking across the parking lot once more, my conversations with Chris and Duncan fresh in my mind, I begin to rethink the valley of death metaphor, not as something to cross over and avoid, but a unique space in which to stay with the trouble. To “stay in the middle of things,” to use Duncan's phrase, suggests a situation where the valley of death is a place to gather, to set up shop and work together. It is not to be avoided, but to be embraced and lived inside of. People are going to be sick and some are going to die. These are facts to be embraced rather than traversed over. As my tour of the basement of the hospital made abundantly clear, research needs to exist alongside the physiological consequences of what doesn’t get translated. Bodies ill, dead and dying are literally, not figuratively, at stake, and an approach to translation that can sit inside that messy truth is far more useful than one that attempts to leap or soar over it.

CONCLUSION TO PART 1:

what *is* translation?

> To comprehend it as a mode one must go back to the original, for that contains the law governing the translation: its translatability. The question whether a work is translatable has a dual meaning. Either: Will an adequate translator ever be found among the totality of its readers? Or, more pertinently: Does its nature lend itself to translation and, therefore, in a view of the significance of a mode, call for it?
>
> \- Walter Benjamin, "The Task of the Translator" (1923)

Part 1 has been about the discursive landscapes of translational medicine, with particular emphasis on a team leading the new medical school and research lab at DMNB in Saint John, New Brunswick. In a word, a lot of the talk around translational medicine I've encountered so far is *deterministic* (Olohan 2017). Translation, as Keith put it, "just fucking happens." This leads to blindspots when it comes to addressing local and individual health concerns that might help practitioners reimagine what can and should be translated, and who ultimately should make those decisions. These concerns will be more meaningfully addressed in Parts 2 and 3, but it's worth pointing out how discourses around translational medicine can limit the extent to which practitioners can imagine and reimagine what it means to translate in the first place. A lack of reflexive engagement with translation itself is one reason places like DMNB struggle to effectively consider the needs and experiences of the people, patients and loved ones, biomedical translations are meant to benefit. The same is true of the driving metaphors shaping how people understand the stakes and pathways available to them when producing biomedical translations. Yet, as we just saw, a deeper appreciation of the valley of death metaphor, for instance, reveals all kinds of novel pathways and modes of engagement. Duncan and Chris provided a nice counterpoint to my conversations with Keith, Petra, Thomas, Bob, Dr. Reiman and others at DMNB. Duncan and Chris highlight what I think is central to the point of my dissertation: it matters what names and categories researchers associate themselves with. Only a deep appreciation for why we align with certain names and categories over others can open up, rather than close off, the possible futures available to our imaginations. This is true within and beyond translational medicine.

Part 1 has also revealed the number of different languages, bodies, devices, institutional stakeholders and fields of inquiry embedded in even the most superficial articulations of translational medicine. This is as much true when thinking of translational medicine as a branding tool building up to the Brunt Lab's ribbon cutting as it is the deep ethical and cross-cultural dimensions of the work Duncan and Chris are doing on TB. In both frameworks we're provided with telling examples of translational medicine's inherent *multi-translationality*. As a result, there is value in understanding how translation has been understood and practiced in other domains, including those implicated in some more recent models of translational medicine, like anthropology (Chiapelli et al. 2015; Hostiuc et al. 2016; Robinson 2017), philosophy (Alving et a. 2013; Bærøe 2014) and information science (Wooler et al. 2017).

To conclude Part 1, I want to take my own medicine, and interrogate for myself what translation is and how I understand it working in translational medicine and other fields, including STS. I will highlight both the disjunctures and overlaps between these fields that reveal the deep challenge *and* opportunity of a truly translational approach to biomedicine.

Translational Medicine is Not a Metaphor

To make sure this doesn't come across as a needless diversion, I should highlight something critical to my interpretation of translation in translational medicine: it is *not* a metaphor. Much more than movements between languages, translation "is able to accommodate a range of concrete, physical elements" (Halverson 1999: 202) as well as interactions across a number of technologies and domains of cultural expression (Olohan 2017, 2019; Robinson 2017). I argue that doing truly translational biomedicine is not a metaphoric practice, any more than translation is a metaphor in literary translation studies, machine learning, philosophy, anthropology or STS, all fields that will intersect with at least some models of translational medicine in the years to come.

Translation is not a metaphor, but it is a complex moral, political, physiological, technological and cross-cultural hodge-podge of concepts and practices (Benjamin 1923; Clifford 1997; Tsing 1993; McLuhan 1964; Venuti 1991;). Every field that aligns itself with translation in some way has their own idiosyncratic ways of understanding exactly what it is and what its stakes are. This is no less true for myself, as a practitioner in STS, a field rich in diverse ways of understanding how and why translation is critical to the success or failure of technoscientific innovations.

Putting My Cards On The Table

Before proceeding, it is probably helpful to offer my own definition of translation. It's one that I think accounts for at least some of the cross-disciplinary complexity of translational medicine outlined above. I think this is a helpful working definition as we begin to make sense of all the competing voices and approaches that need to be brought together in translational medicine.

I define translation as ***the imperfect movement and alteration of ideas, symbols, and material entities between two or more domains of cultural expression.*** This umbrella definition is useful for three reasons. First, it avoids overemphasizing source and target domains or narratives of original versus approximate or secondary texts, devices, and ideas in the procedures and products of translation. Second, it highlights that translation is an inherently cultural activity, one that, if treated in a care-filled manner (de la Bellacasa 2017), can generate what Homi Bhabha calls:

> …hybrid sites of meaning" that "open up a cleavage in the language of culture which suggests that the similitude of the *symbol* as it plays across cultural sites must not obscure the fact that repetition of the *sign* is, in each specific social practice, both different and differential (1991: 163; emphasis in original).

Finally, this definition avoids assuming that translation is exclusively concerned with the linguistic domain, pointing instead to a richer understanding of the concept embedded in its etymological history.

If translational medicine is first and foremost concerned with the *actual* practice of translation, this implies translation across a multiplicity of languages, living and simulated bodies, spaces (both physical and digital), scales, political contexts, as well as the goals of both public and private interest groups. Before bringing these worlds together, we need to take stock of how each of them understand the stakes and contours of translation. This is where critical intersections between translational medicine as my "object" of study and STS as my field of practice become so useful.

After an overview of the history and etymology of translation, this conclusion to Part 1 provides deeper insight into how translation is understood in computer science, philosophy, literary studies, media theory and anthropology. All fields that are in some way implicated in discourses around translational medicine. I emphasize how each of these fields recognizes, to some extent, the inherent necessity and impossibility of translation. I then highlight how STS can help bring translational medicine into deeper conversation with these fields.

Inspired by Douglas Robinson's 2017 book, *Translationality*, we can think of this conclusion to Part 1 as an attempt at a kind of "translational-medical humanities." From this point of view, I ultimately argue for a more ecological and heterogeneous model of translational medicine, one that helps avoid narrow frameworks that can turn too quickly into unhelpful metaphors for commercialization (Ghoda, Rosen and Kwak 2020; Mahant 2020; Seyan 2019).

The History and Etymology of Translation

The word "translation" is itself a translation across a range of historical periods and cultures (St. André 2010). According to Sandra Halverson, the "term *translation* has its origins in Latin. The English verb *translate* was formed from the past participle, *translatus,* of *transferre* (trans + *ferre,* 'carry over')" (1999: 199). The verbs most often identified as precursors to translation are the Latin words *wendan*, meaning "to turn," and *awendan,* "to turn into" (Nichols 1964; Halverson 1999). Since at least the fourteenth century associations between translation and language have existed alongside associations with both literal and figurative movements of bodies, alterations in direction and position, and also changes of state (Halverson 1999: 200). In the Renaissance, translation "had many more meanings, and a much fuller semiotic range. Included in that range of meanings was the use of the word to refer to the movement or translation of souls or the body to heaven" (Rubel and Rosman 2003: 20). It is only in the last century or so that translation has come to be associated almost exclusively with conversion between written and spoken languages, ideally without a remainder of meaning or interpretation.

The *Oxford English Dictionary* defines translation as “the act of all translation (or its result)” (*OED Online*, June 2016), a uniquely hilarious example of a snake eating its own tail. The *OED* identifies three categories of English usages of translation. The first category has to do with translation as the literal and figurative movement of entities across space and time, and includes three sub-uses: “removal or conveyance from one person, place, or condition to another,” the “removal from earth to heaven,” and “the transference of disease from one person or body part to another”, (*OED Online,* June 2016). The last of these is increasingly rare but I would argue critically important in trying to understand the kinds of translation at play in contemporary biomedical research (Davies 2012).

The second category outlined by the *OED* came into fashion around the same time as the first, approximately the middle of the 14th century, but currently holds a privileged position in English speaking cultures. This second category has to do with the literal and figurative translation of language and meaning between bodies, cultures and media, including:

> a. The action or process of turning from one language into another; also, the product of this; a version in a different language.
> b. *transf.* and *fig*. The expression or rendering of something in another medium or form, e.g. of a painting by an engraving or etching; also *concr.*
> c. *Biol.* The process by which genetic information represented by the sequence of nucleotides in messenger RNA gives rise to a definite sequence of amino-acids in the protein or polypeptide that is synthesized (*OED Online,* June 2016*).*

The third category outlined by the *OED* has to do with law and automation, including rare but significant usages like “the transfer of property” and the automatic retransmission of a message through the use of a relay in long distance telegraphy (*OED Online,* June 2016*)*.

Elements of all three of these categories of translation are at play in translational medicine, making it exceptionally difficult to imagine how anyone would find common ground in biomedical collaborations, especially an agreed upon understanding of what, when, how and by what means they are translating. In each of these three categories of translation there exists a complex duality, a “here” and “there” implied by passages of time, space and matter. The extent to which something is changed through the process of translation is unpredictable, and the idea of a one to one correlation between here and there is impossible (Derrida 2001). Yet, this impossibility does little to deter people from assuming a certain necessity in *trying* for the best possible translations (Buden 2006).

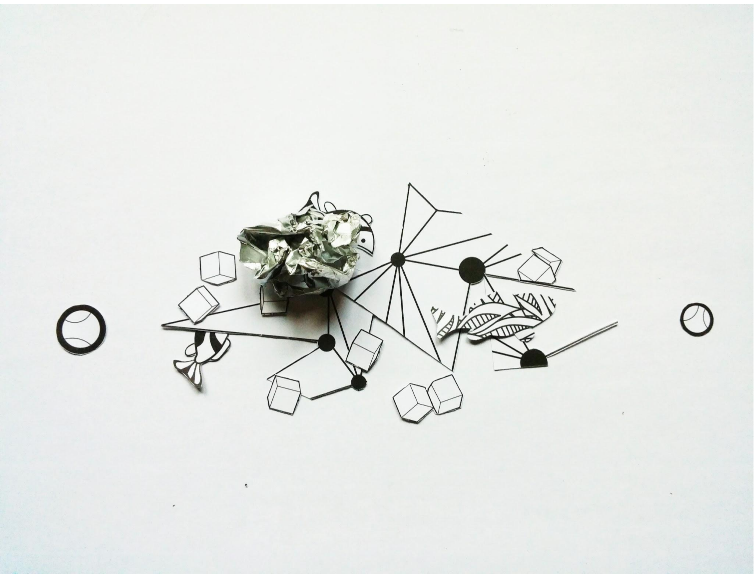

Figure 4: "Cam's Umbrella Definition of Translation." Sculpture by Jenna Mariash and Photo by Author (2014).

Translation <u>and</u> Metaphor, not Translation <u>as</u> Metaphor

Translation shares a rich history with metaphor and analogy. As James St. André puts it, "the original meaning of the term translation in various languages is itself metaphorical: the Latin derived terms 'to translate', 'traduire', 'traducere', and the German *Übersetzung* mean 'to carry over,' 'to bring over'" (2010, 2). Translation studies scholar Ben Van Wyke has emphasized the entanglement of metaphor and translation by reminding us that:

> The word for translation in English, as well as in many other European languages, comes from the Latin *translatio*, which is a translation of the Greek *metaphora*, the word from which English derives "metaphor". In ancient Greek, *metaphora* was used in the sense that we employ the word "metaphor" today, as well as for translation from one language into another. Thus, related in this way, translation and metaphor both imply the notion of carrying over or transferring meaning from one word or phrase to another (2010, 18).

These historical and etymological connections have led to assumptions that translation is itself inherently metaphorical. As St. André puts it, "the persistence and abundance of metaphorical language…to describe translation would seem to indicate that there was something about the process of translation which was best understood indirectly or by analogy" (2010, 2). In the interdisciplinary field of literary translation studies (TS) there has emerged an increased distrust of metaphorical language to describe the process of translation, particularly for those hoping to establish TS as a scientific field of research (Sarukkai 2001; Venuti 1991). St. André (2010, 3) identifies two key groups that have informed this distrust: 1) translators who are not theorists; 2) theorists whose ideas are unclear. Describing the second group he argues that "theorists unable to explain what they mean, resort to using metaphors that, while suggestive, do more to cover up the fact that the ideas have not been thought through properly than to help us think clearly about what happens during the translation process" (2010, 3-4). My interest in addressing the broader cultural and historical significance of translation is related to similar concerns regarding the assumed relationship between metaphor and translation in biomedicine.

First of all, I am worried about assumptions embedded in social studies of translational medicine that "translation" is being used metaphorically.[31] It's often described as a catchphrase (Keating and Cambrosio 2012) for something that already

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[31] By way of a quick ethnographic field note: It is late November 2011 and I am waiting for a bus after the final meeting before winter break of a graduate course in York University's Department of Anthropology. This half of the full year theory course considered critical foundations on which contemporary social and cultural anthropology have been built. I look over the term paper that our professor has just returned to me. The paper is titled "The division of labour in translational medicine," a playful attempt at combining Adam Smith's division of labour, Émile Durkheim's notion of organic solidarity and Donna Haraway's world-making practices to explain the wide range of workers implicated in models of translational medicine. Marginal notes reveal positive and critically engaged feedback from the professor but for one curious factor. The professor has added red scare quotes to every instance of my use of the word translation, implying that the word is necessarily being used metaphorically. The first instance of these scare quotes comes up in my broad definition of translational medicine in the paper's introduction: "…especially true in the case of translational medicine, a field that involves loose collaborations between people from multiple research backgrounds coming together to 'translate' experimental results into clinical and commercial applications." "But it's not a metaphor," I scribble next to this first doctoring of the word translation, "people just don't understand what it means."

exists, or "old wine in new bottles" (Wilson 2015). For others, it is simply the wrong word.

As an example, consider Kaushik Sunder Rajan and Sabina Leonelli's "dossier on translational research in the life sciences" for the journal *Public Culture*. In their introduction Rajan and Leonelli include a consideration of how translation has been theorized not only in STS and translational medicine but also in literary and linguistic fields (2013, 467). They seem willing to seriously question the complex geometric, material *and* linguistic associations that make translation such a rich, contested and persistent concept in diverse areas of scholarship. As Rajan and Leonelli put it: "Enabling and managing such mobility requires extensive efforts and, indeed, requires us to think about that key concept embedded in the very name 'translational research,' which is translation" (Rajan and Leonelli 2013, 467). As noted in my methodological introduction, these authors take seriously the emergence of translation as an actor's category in biomedicine then make a confusing pivot:

> ...it is worth asking whether translational research, in fact, is concerned with translation at all. More generally, what kinds of transformations or transactions (including, but also other than, translation) does translational research point to? (Rajan and Leonelli 2013, 467).

Yet, the word used to designate this mode of biomedical research, the "actor's category" as they themselves put it, is not "other than" translation, it is not "like" translation, it *is* translation. So, I want to carefully interrogate what the word means, how it has been deployed in other research domains and, ultimately, how it might be better understood and deployed in biomedical contexts-in-the-making like DMNB.

My second concern, and the one that informs the valley of death case study that preceded this chapter, has to do with unhelpful metaphors that proponents use to explain and promote translational medicine. Downplaying the metaphoricity of translation in translational medicine allowed me to navigate the valley of death metaphor, for instance, with greater clarity. The metaphors used to describe the process of translation are troubling because the inherent richness and complexity of biomedical collaborations are diminished, lessening the impetus and possible sites by and through which, for instance, less informed publics might actively be engaged in decision-making.

So, once again, if we think of translational medicine as being *literally* about the translation of different ways of knowing into improved health and innovation, we need to find some common ground between disparate fields of inquiry and practice. As I've already mentioned, one critical throughline between multiple fields of research where translation plays a critical role is the assumed necessity and impossibility of translation. As a starting point, the simultaneous necessity and impossibility of translation provides a pathway to a modesty-driven approach to cross-cultural exchange and cross-disciplinary collaborations that could benefit a wide range of translational research initiatives.

The Necessity and Impossibility of Translation

Researchers in computer science, literature, cognitive science, media theory, and anthropology have all lamented a core issue with translation: that it is impossible. These same researchers, however, discuss the inherent imperfection and impossibility of translation alongside some sense of its necessity in daily life, particularly with reference to its capacity to foster connections across perceived cultural boundaries. Translation becomes a push towards an ideal that can never be fully realized. As Anna Tsing has argued, translations "open up spaces of indeterminacy in which new, unexpected cultural forms arise" (1993, 255), a point that seems fundamental to the kinds of translation at stake in biomedicine.

Warren Weaver, the 20th century scientist and mathematician responsible for pioneering work on machine translation, opened a famous memorandum with a particularly salient and troubling understanding of the necessity and impossibility of translation:

> There is no need to do more than mention the obvious fact that a multiplicity of language impedes cultural interchange between the peoples of the earth, and is a serious deterrent to international understanding. The present memorandum, assuming the validity and importance of this fact, contains some comments and suggestions bearing on the possibility of contributing at least something to the solution of the world-wide translation problem through the use of electronic computers of great capacity, flexibility, and speed (1949, 1).

Weaver's understanding of the "world-wide" translation problem assumed that overcoming the multiplicity of languages is an important step towards finding an invariant, universal core of all human language. Asking us to "think by analogy," Weaver imagines:

> ...individuals living in a series of tall closed towers, all erected over a common foundation. When they try to communicate with one another they shout back and forth, each from his own closed tower. It is difficult to make the sound penetrate even the nearest towers, and communication proceeds very poorly indeed. But when an individual goes down his tower, he finds himself in a great open basement, common to all with the persons who have also descended from the towers (Weaver 1949, 11).

Noting that the "direct route" of shouting across towers should give way to individuals descending from each language "down to the common base of human communication–the real but as yet undiscovered universal language–and then re-emerge by whatever particular route is convenient" (1949, 11), Weaver highlights a core tension in understanding the conceptual and practical limits of translation. This tension lies in the simultaneous push towards universal ambitions (the discovery of universal language) and the necessity of recognizing and taking seriously cultural difference and specificity. This implies that inherent to translation are political and ethical dimensions that need to be addressed in any attempt at defining its goals and its limits.

These tensions have been most richly navigated in the realm of critical literary studies. Many contemporary literary translation scholars were inspired by Walter Benjamin's "Die aufgabe des übersetzers" (translated as the "Task of the Translator" in English) and have spent the last 50 years going to great lengths to identify the various ways in which translation is not a thing or even a unidirectional process. Rather, translation is increasingly described as an indeterminate (Quine 1970) and multi-directional enactment, which is critical to the ecological model presented by feminist STS practitioners:

> In fact, there is no possibility of wholeness, totality, or perfection in any phase of the text's life: it is born as a *translatio*...and it exists as just that. It exists when it is perceived; it is only and always the version created by the reader's act of translation (Macadam 1975, 749)

Jorges Luis Borges, in his *Las versiones Homéricas* (translated as either "Some versions of Homer" or "The Homeric versions") offers an especially sprawling take on the idea that translations are forever in motion, not only in the movement between languages but between understandings of textual origin and completion:

> What are the many translations of the Iliad, from Chapman to Magnien but different perspectives on an object in motion, a long, experimental game of omissions and emphases? (There is not even any need to compare French and English translations; the same contradictions appear within the same language.) To presuppose that any recombination of elements is necessarily inferior to its original is to presuppose that rough draft 9 is necessarily inferior to rough draft H. Of course there can be nothing but rough drafts. The concept of the "definitive text" belongs only to religion or Fatigue (Borges 1941, cited in Macadam 1975).

These examples emphasize something that has only become more prevalent in studies of translation as more than just language conversion: questioning the very possibility of a one-to-one correlation, or unidirectional movement, between targets and sources.

In early philosophical discussions of translation this question came down to concerns as deceptively simple as whether a target text needed to contain the same number of words as the so-called original. Cicero, in *De Oratore*, is one of the earliest thinkers to suggest that what needs to be transmitted is some "sense" of the source language but not necessarily a word-for-word correlation. Jacques Derrida, addressing a room of literary translators, once suggested that:

> ...Cicero freed translation from its obligation to the verbum, its debt to word-for-word. The operation that consists of converting, turning (*convertere, vertere, transvertere*) doesn't have to take the text at its word or to take the word literally. It suffices to transmit the idea, the figure, the force (2001, 180).

It does not take long to move from questioning one-to-one linear movements to more politically motivated questions concerning the so-called transmission of ideas, figures and forces at work in translation of all kinds.

In the interdisciplinary field of translation studies (TS) that emerged in the 1990s, a number of researchers have emphasized a "radical distrust of the possibility of any intrinsically stable meaning that could be fully present in texts" and that could be "recoverable and repeated elsewhere without the interference of the subjects, as well as the cultural, historical, ideological, or political circumstances involved" (Arrojo 1998, 25). The goal of translation studies is to unpack the social, technical and cultural factors which contribute to the process through which a text is translated. Bassnett & Lefevere (1990), for instance, describe the "cultural turn" in translation studies, emphasizing how "translation has been a major shaping force in the development of world culture" (1990, 12).

One of the defining problems in translation studies is the argument over whether translators should apply *domestication* or *foreignization* to their translations. In domestication the translator alters the values of the source language in order to render a work more readable for audiences in the target language. This has the effect of making the translator invisible and causes an "ethnocentric reduction of the foreign text to target-language cultural values" (Venuti 1995, 20). In foreignization, the values of the source language are kept, thereby exposing them to readers in the target language. Foreignization makes the work of the translator visible and works to "disrupt the cultural codes that prevail in the target language" (Birdwood-Hedger 2007). Foreignization has been championed as a way of moving the reader "closer to the writer" (Hatim 2001, 46).

An Anthropology of Translation

As we move further from domains focused on literature and linguistics, we see a similar set of concerns regarding the extent to which translation is both impossible and necessary. This is especially true in cultural anthropology, a field that perhaps even more than critical literary studies has spent decades reflecting on its violent histories of colonial power and oppression. The so-called cultural turn (Clifford 1986; Kalb and Tak 2006) in anthropology has been much richer than other academic "turns," in that it has sought to embrace and live inside its own political and ethical flaws, to make the production of research as politically charged as its content. As a result, the last couple decades has witnessed increasing attention paid to the multiple translations at work in cultural anthropology's research practices and ethnographic renderings. As Catherine Tihanyi has argued:

> ...this deceptively simple act requires travels through invisible universes of verbal and nonverbal meanings. There is so much more to translation than meets the eye. Its invisible components include not only the layers of complexities of language in its linguistic, pragmatic, and cognitive aspects but also the cultural, political, and other contextual components in the expression and transmission of meaning (2004, 739).

Via its history of violence, appropriation and colonization, cultural anthropology is a productive field from which to navigate political, cultural and extra-linguistic notions of translation. Critical to this is understanding the "entire enterprise" of anthropology, from handwritten or typed field notes and audio interview recordings to the power dynamics at play in participant observations as elements of translational labour:

> The European explorers and travelers to Asia and later the New World were always being confronted with the problem of understanding the people whom they were encountering. Gesture and sign language, used in the first instance, were soon replaced by lingua francas and pidgins, and individuals who learned these lingua francas and pidgins became the translators and interpreters....These pioneers in cross-cultural communication not only brought back the words of the newly encountered people but also became the translators and communicators of all kinds of information about these people, and the interpreters of their very differing ways of life, for European intellectuals, and the European public at large. They were also the individuals who were the basis for the conceptions which the Others had of Europeans (Rubel and Rosman 2003, 1).

Anthropologists explore questions that overlap with those in translation studies more broadly, including the visibility of the work of anthropologists as translators. Yet, built into these concerns is something seemingly more complex and reflexive, at least in terms of the factors that need to be addressed in questioning the strengths and weaknesses of translation in anthropology. In particular, data collection and methodological considerations have become increasingly important ways of exploring the political motivations and power imbalances at work in cultural anthropology (Clifford 1997; Tihanyi 2004; Tsing 1993).

This seems particularly salient for better addressing how translation operates in biomedical contexts. Should we not be just as concerned with research in terms of the "evaluation of information in terms of how it was collected, whether it was based on actual observations or casual conversations, which languages were used, who was doing the translations and what were the methods used"? (Rubel and Rosman 2003: 2). Anthropologists accept the inherent impossibility and necessity of translation in their work, but also in the rendering of that work into a final product:

> Translation within the context of fieldwork, the subsequent analysis of the field material to gain understanding of the meanings and behaviours of a people other than one's own, and the writing of the ethnographic parallel only in part the translation of literary texts…..In addition to the ethnography as the translation of a culture in order to understand it, meaning its translation into some Western language, there is another kind of translation which ethnographers perform….The ethnographer, who sees societies as having similarities as well as differences, will 'translate' what has been found on the local level into a series of analytical concepts which will then enable comparison with other societies (Rubel and Rosman 2003, 12).

Questions of performance, the media through which data is collected and, ultimately, the final rendering of research into a product (lecture? Commercially available books? Documentary film?) all impact questions concerning the benefits and limitations of individual research projects in anthropology. At the same time, there are even larger questions concerning the audiences of anthropological knowledge:

> To what extent can the public accept the provisionality of the anthropologist's account? Some say they can. Others see this provisionality as undercutting anthropology as a discipline. There is a difference regarding this point if we are talking about the anthropological public or the general public. The public needs to be educated about the provisional nature of anthropological categories, and the way anthropologists 'translate' native categories (Rubel and Rosman 2003, 16)

Key to these concerns is the fact that anthropology is about crossing (and sometimes violating) cultural boundaries. In the words of James Clifford, "[t]he diasporic and hybrid identities produced by these movements can be both restrictive and liberating. They stitch together languages, traditions, and places in coercive and creative ways, articulating embattled homelands, powers of memory, styles of transgression" (1997, 10). In addressing a similar concern, Anna Tsing has argued that it is important to avoid emphasizing origins in our thoughts about translation, but rather to focus on an ecology of heterogeneity: "…there are no originals, but only a heterogeneous continuum of translations, a continual process of rewriting in which meaning–as well as claims of originality and purity–are made" (1993, 253).

Translation Is Always Mediated

By emphasizing the ways in which every facet of anthropological labour is translational, I also mean to highlight the vast array of technologies, languages, cultures and modes of mediation at stake in translational medicine. In *Understanding Media,* Canadian media theorist Marshall McLuhan dedicated an entire section to describing "media as translators," a simultaneously literal and figurative engagement with how electric media reshape ways of knowing and communicating our reality. For McLuhan, translation is a "'spelling-out' of ways of knowing" (1964, 63). Predicting our increasing reliance on big data and flows of information, made even more explicit by our increased embeddedness online, McLuhan argued that:

> In this electric age we see ourselves being translated more and more into the form of information, moving toward the technological extension of consciousness….We mean that we can translate more and more of ourselves into other forms of expression that exceed ourselves (1964, 64).

This is a critical point, especially in a biomedical context so consumed with the so-called "explosion" of data and information in the last three decades. Most fascinating are the ways in which single points of data can be endlessly reproduced and newly translated for any number of research projects (Pearce et al. 2010). Interestingly, McLuhan makes an explicit connection between translation and applied knowledge, with phrasing that feels uniquely relevant to social studies of translational medicine: "The long revolution by which men have sought to translate nature into art we have long referred to as 'applied knowledge.' 'Applied' means translated or carried across from one kind of material form to another" (1964, 65).

Remaining sensitive to the inherently mediated nature of translation makes more palatable the argument that translation is not used metaphorically in translational medicine. We translate as much across materials and spaces as we do words and ideas, something fundamental to technoscientific fields that have proposed models, theories and approaches to translation. In this way, there are actually quite a number of overlaps between enactment and feminist STS and the implied goals of translational researchers like Keith and Duncan. In each domain, an entrepreneurial appreciation for the mess of technologies, bodies, ideas and commercial sensitivities have shaped complex understandings of what, why and how particular bits of knowledge can or should be translated.

Translation in STS

STS and translational medicine bear an uncanny resemblance to one another, one that took me a long time to fully appreciate. Sure, they both talk a lot about translation and innovation, but there are other important overlaps as well. They are both products of the changing face of entrepreneurial science in the mid-twentieth century (Mirowski & Sent 2008). And both seem to have multiple schools of thought, some for whom translation is deep-rooted and serious and others for whom it is but a useful conceptual tool or catchphrase (Engebretsen, Sandset and Ødemark 2017). The difference is that, there have been over 40 years of debates around what translation is and how it works in STS, a history worth parsing in order to better understand how translational medicine might better engage the non-medical fields that I think are so critical to its success.

At the same time, however, I think it is worth noting how STS as a field of practice has much to teach translational medicine about how to hold together all the seemingly disparate stakeholders, fields of inquiry, devices, languages and bodies that need to effectively translate across and between one another. At the same time, the field of STS can and should be criticized for its own sometimes lackluster appreciation for the multi-translationality of technoscientific innovation, especially in approaches that often lean into reproducing the tenets of late industrial innovation.

From Critics to Advisors

In 2002, Madeleine Akrich, Michel Callon and Bruno Latour published a two part overview of a series of workshops they conducted with business students. The papers were titled “The key to success in innovation part I: The art of interessement” and “The key to success in innovation part II: The art of choosing good spokespersons.” Having spent nearly three decades building their actor-network theory (ANT) approach to STS, these papers flipped the script. Rather than a descriptive critique of how technoscience operates, the papers read like a how-to manual for entrepreneurs who want to be more sensitive to what is really going on in technoscientific innovation. Rather than linear models, Akrich, Callon and Latour spoke of complex multidirectional networks, but in the tone of advisors rather than critics. They laid out a challenge that sounds fittingly like the valley of death described above:

> The nuts and bolts of the plot are well known. On the one hand is invention i.e. ideas, projects, plans, and yet also prototypes and pilot factories: in a word, all that occurs prior to the first uncertain meeting with the user and the judgment he will pass. On the other hand is innovation in the strict sense of the word i.e. the first successful commercial transaction or more generally, the first positive sanction of the user. Between the two extremes is a fate played out in accordance with a mysterious script. Firms which are either going downhill or thriving, nations which are in decline or becoming hegemonic. A project deemed to be promising by all of the experts which suddenly flops, while another in which everybody lost faith suddenly transforms itself into a commercial success (2002, 187-188).

Echoing Austrian economist Joseph Schumpeter, the authors emphasize the role of the entrepreneur as a mercurial figure capable of turning ideas into successful technoscientific products. It is here where they make an explicit claim about translation and the translatability of knowledge. In doing so, they evoke a weird combination of Marshall McLuhan and Vannevar Bush:

> The entrepreneur is this exceptional being who, in hedging his bets on invention and markets, knows how to bring an intuition, a discovery, a project, to the commercial stage. He is the mediator, the sheer translator, who brings together two universes with distinct logics and horizons, two separate worlds, each of which would not know how to survive without the other (2002, 188).

There are a number of connections that one might trace between the historical trajectories of STS and translational medicine. Both STS and translational medicine are byproducts of an entrepreneurial model of scientific and technological innovation that emerged over the course of the 20th century (Owens 1994; Etzkowitz 2002; Jones 2009). Entrepreneurial science was, from its inception, driven by what Vannevar Bush and his colleagues hoped would be the coming together of teaching and research alongside the so-called “capitalization of knowledge” (Etzkowitz 2002: 1). This necessitated the coming together of research universities, government agencies and private companies.

Both STS and translational medicine, and public discourse surrounding them, emerged out of concerns with ways of understanding how technoscientific knowledge and innovations are produced and disseminated in professional and increasingly entrepreneurial research environments . At the same time, both domains share an interest in opening up the actors relevant to the processes by which technoscience succeeds and fails (Latour 2005; Hostiuc et al. 2016). This includes an increased interest in engaging the public in determining how and whether to support risky research.

I am particularly interested in how debates about what translation can and should look like in STS and translational medicine might be combined in the generation of better models of biomedical research *and* the study of technoscientific success and failure in STS. Not to mention how people working in translational medicine might challenge themselves to really question what they mean when they say translation, and how they can best learn to work with those in information science, philosophy, sociology, anthropology, and political economics, among others (including STS itself).

Translation as Object and Strategy in STS

One might argue that detailing the process of technoscientific translation is precisely what, at least in the beginning, distinguished STS from other areas of inquiry into the inner-workings of science (including so called “internalist” histories and philosophies of science).[32] Karl Popper (1961), for instance, might talk about "translatability" between multiple geometries, or between theories and observation states, but he had little to say about the cross-cultural exchanges necessary to facilitate that work to begin with.

STS has used translation as both an object and a strategy of research design and practice (Latour & Woolgar 1979; Callon 1986; Galison 1997; Latour 1984, 1988; Star and Griesemer 1989). At the same time, researchers have emphasized the ways in which translation is an inherently misleading, confusing and impossible to fully trace process. Bruno Latour has argued that "to translate is to betray: ambiguity is part of translation" (1996, 48). In ANT, translation has been treated as the slow, complex and inherently imperfect movement of artefacts, interests, ideas and bodies that generate new knowledge and innovations (Latour 1987).[33] As John Law puts it, "translation is both about making equivalent, and about shifting. It is about moving terms around, about linking and changing them" (2009, 144). To translate is to engage in an inherently imprecise and uncertain process that is prone to failure (Law 2009). According to Michel Serres, the philosopher widely regarded as the inspiration for ANT's treatment of the concept, translation is not a linear movement, but a generative and inventive (re)configuration of seemingly disparate material and semiotic elements. Callon puts it this way:

> Considered from a very general point of view, this notion (translation) postulates the existence of a single field of significations, concerns and interests, the expression of a shared desire to arrive at the same result...Translation involves convergences and homologies by relating things that were previously different (1980, 211).

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[32] In the externalist/internalist debate there emerged new ways of thinking about history that no longer needed to move from individual genius to individual genius in a long succession of unidirectional progress (Lightman 1997). At the same time, researchers were concerned with an overly externalist approach that emphasized a deterministic understanding of social, political and economic contexts in the production of scientific knowledge. Not to mention concerns that, until the 1980s, most researchers privileged the contexts in which elite scientists worked and lived, to the detriment of an understanding of how women and subaltern populations, among others, contributed to the rich fabric of scientific knowledge and labour (Russett 1989).

[33] Practitioners of actor-network theory (ANT) developed a four stage model of technoscientific translation: problematization, interessement, enrollment and mobilization (Callon 1986; Randall et al. 2007).

ANT strived to unveil “mechanics of power” (Law 1992), focusing on the translation of personal and collective interests. As Joan Fujimura put it: “A major strategy used by scientists in fact-making is to translate others’ interests into their own interests. More generally, translation is the mechanism by which certain entities gain control over the way society and nature are organized…” (1988, 262).[34] To translate is to engage in an inherently imprecise and uncertain process that is prone to failure (Law 2009).

Many studies in STS and adjacent fields look at how novel technoscientific findings are moved from laboratories into scientific publications, new instruments, disciplinary fields, commercial products and, in some cases, to lay social imaginaries through the popular press (Latour 1988; Waldby 2000; Dumit 2004; Keating and Cambrosio 2003). Rather than treating translation as a neutral concept, for instance, early STS scholars actively troubled the meaning and usage of translation as a central concept in their work. While maintaining the concept’s rich etymological origins, STS researchers have traced the ways in which translation can simultaneously expand and limit possibilities for successful technoscientific innovation.

There are echoes of the problems facing researchers in literary translation studies in many STS accounts of translation. Michel Callon, for instance, built a name for himself based on a paper emphasizing the role of *domestication* in the process of translation that stabilizes scientific facts. As he put it, translation is a process “during which the identity of actors, the possibility of interaction, and the margins of maneuver are negotiated and delimited” (1986, 68). Through translation, both scientists and

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[34] Procedures that shape and get shaped by the control and organization of society exist uneasily alongside the fact that “translation is both about making equivalent, and about shifting. It is about moving terms around, about linking and changing them” (Law 2009: 144).

non-scientists can be brought together, through a series of negotiations in order to accomplish a common goal. This, one might reasonably argue, is precisely what proponents of translational medicine, regardless of the extent of their emphasis on commercialization, are trying to do. In Callon's account, translation is conceived as a powerful and problematic process:

> Translation is the mechanism by which the social and natural worlds progressively take form. The result is a situation in which certain entities control others. Understanding what sociologists generally call power relationships means describing the ways in which actors are defined, associated, and simultaneously obliged to remain faithful to their alliances (1986, 82).

Significantly, both ANT and feminist epistemologists agreed that translations were not one-to-one reproductions of a scientific problem or finding. Rather, translations are "displacements." As Bruno Latour argues, in translation "there is a real displacement through the various versions" (1983, 260). At the same time, translations are marked by the ideological, historical, social, economic and political contexts within which translators, whether human or nonhuman, are situated. In Callon's words, technoscientific translation involves a process through which actors domesticate their interests in the hopes of mobilizing, stabilizing and collaboratively engaging relationships with other stakeholders. This, again, overlaps in powerful ways with the kinds of challenges facing researchers I worked with in Saint John, and I'm sure any number of other emerging translational research hubs around the world.

Towards an Ecological Model of Translational Medicine

Though ANT has been broadly influential, it has also been heavily criticized, particularly by feminist science scholars, for its overemphasis on metaphors of war, competition and consensus (Star & Griesemer 1989; Haraway 1991). Feminist STS developed a partial, ecological model of translation, identifying feminist science as a practice of modest and incomplete translation:

> Feminism loves another science: the sciences and politics of interpretation, translation, stuttering, and the partly understood. Feminism is about the sciences of the multiple subject with (at least) double vision. Feminism is about a critical vision consequent upon a critical positioning in inhomogeneous gendered social space. Translation is always interpretative, critical, and partial. Here is a ground for conversation, rationality, and objectivity—which is power-sensitive, not pluralist, 'conversation'" (Haraway 1991, 195)

For Haraway, translation was best understood as an incomplete and contestable but also potentially liberating practice. This was because, in part, translation could help both scientific researchers *and* STS scholars remember that the world can always be made anew. As she put it, the "point is to learn to remember that we might have been otherwise, and might yet be, as a matter of embodied fact" (1997, 39). Comparable issues were raised by Susan Leigh Star and James Griesemer, in their critique of ANT's notion of *interessement*. Their influential paper considered "the ramifications of the heterogeneity of scientific work and the need for cooperation among participants for the nature of translation among social worlds" (1989: 388). Rather than "consensus," the ecological model of translation outlined by Star & Griesemer focused on traces of multiple perspectives, interests and histories that generate temporary resolutions in scientific collaboration. Their understanding of translation embraced indeterminacy and fleeting moments of temporary stability and consensus:

> Translation here is indeterminate, in a way analogous to Quine's philosophical dictum about language. That is there is an indefinite number of ways entrepreneurs from each cooperating social world may make their own work an obligatory point of passage for the whole network of participants. There is, therefore, an indeterminate number of coherent sets of translations (1989, 391).

In emphasizing indeterminacy in their model of translation, Star and Griesemer developed the notion of "boundary objects," which in their words "are adaptable to different viewpoints and robust enough to maintain identity across them" (1989, 389).

It is just outside the boundaries of disparate disciplines and technologies that Peter Galison's (1997) notion of "trading zones" becomes so important to discussions of translation in STS and technoscientific innovation more broadly. For Galison, the capacity to explicitly translate across different languages isn't the only way for two different research fields to connect with one another. The notion of "trading" was inspired by, among other things, anthropological studies of gift giving and the uniquely partial languages that are developed to facilitate these exchanges. At the boundary lines between different disciplines, languages are formed that have more in common with Creole or pidgin (Galison 1997; Sarukkai 2001). For Galison, viewing translation as a purely linguistic act misses the multiple layers of social interaction and materiality that are critical to connecting across differences in technoscientific innovation.

ANT practitioners, on the other hand, tended to shape their work as though it was coming from a single viewpoint, as they narrated the unidirectional translation of interests from scientists into those of non-scientists (Callon 1986), or the other way around, rather than a multitude of partial perspectives (Haraway 1989) and simultaneous translations. Star and Griesemer would appear to be countering an overly linear model of translation outlined by ANT with a multidirectional and, indeed, *multi-translational* model of translation examined through their ecological framework.

STS and Translational Medicine

In translational medicine it might be time to reinforce the value of ecological, flexible and multi-directional models of translation, models that I argue are shared by feminist STS researchers (Haraway 1991; Star and Griesemer 1989) and a subset of translational researchers trying to challenge the confines of commercialized biomedicine, like Duncan and Chris. A more flexible and nuanced understanding of translation, one not tied so explicitly to the rhetoric of unidirectional linearity, efficiency, and commercialization can help us generate more thoughtful approaches to navigating the inherently unknowable future of biomedical research. Adhering to unproductive and lazy models and metaphors will leave diverse publics decidedly unprepared if and when they are asked to perform in their various roles as taxpayers, patients, research participants and, perhaps one day, decision makers in biomedicine.

This is where a broader appreciation of the history, etymology and disciplinary uses of translation become important. Translational medicine requires people to remain mindful that translation is simultaneously linguistic, material, spatial, temporal and geometric, possessing a rich multiplicity of meanings and associations. This is one of the major reasons why the concept of translation has informed so many seemingly disparate fields of research. ANT, for instance, began as a "sociology of translation", a way of understanding how particular knowledge producers come to possess power and influence on other researchers and the broader public (Latour 1987, 1988; Callon 1986). Translation's rich etymological history has certainly not been lost on Bruno Latour:

> It should now be clear why I used the word *translation*. In addition to its linguistic meaning (relating versions in one language to versions in another one) it has also a geometric meaning (moving from one place to another). Translating interests means at once offering new interpretations of these interests and

> channelling people in different directions. 'Take your revenge' is made to mean ‘write a letter’; 'build a new car' is made to really mean 'study one pore of an electrode'. The results of such renderings are a slow movement from one place to another (1987, 117).

In both STS and translational medicine, translation is best understood as a series of limiting movements and assemblages. Translation might not itself be a metaphor in translational medicine but the inherent ambiguity of translation necessitates the use of metaphoric language to explain what it is, how it should be done, and who it should benefit. The “valley of death,” for instance, offers a troubling, but arguably helpful, geography from which to consider the materiality of language in biomedical cultures and, in the case of translational medicine, the overlooked deliberative role of non-experts in shaping the future of research, practice and policy.

In 2007, Janet Atkinson-Grosjean described what she called an emerging “ethics gap” in contemporary biomedical cultures. The gap was the result of increasingly blurry boundaries between public and private interests in biomedical research. Translational medicine, she argued, should be designed to close this gap, or at least make it manageable. Translational medicine was, in her words, a way of embracing the “messy reality” of biomedical research, arguing that the field should be first and foremost concerned with the development of “hybrid” and “boundary” organizations.

Promissory Translation

Let us not be mistaken, translation as a category and mode of research has emerged at a time when biomedicine is becoming increasingly entrepreneurial, increasingly subjected to the whims, interests and logic of late capitalism (Cooper 2011; Rose 2006; Rajan 2007; Helmreich 2008). It is not surprising that proponents of translational medicine have latched onto a rhetorical device that frames innovation in terms of war and life-threatening journeys through desolate landscapes. The skeletons and falling bodies, the researchers, doctors and patients waiting on either side of the valley of death, for instance, remind us that biomedical innovation is both risky and challenging. At the same time, there is no denying that an important goal of translational medicine in North America is the effective commercialization of new diagnostic and therapeutic tools. But this isn't the whole story.

Biomedical translation is, for many proponents, about generating novel tools for diagnosing and treating human diseases, through flexible collaborations across a multiplicity of scales, disciplines, bodies, communities and technologies. Commercialization, for a number of my interlocutors, is of secondary importance. As a result, one might reasonably ask whether there are better ways to articulate the unique local and global challenges facing translational researchers, that can better account for the *multi-translational* potential of biomedical knowledge.

Downplaying the need to assume a pre-existing context in which translational medicine is situated does not mean that this project is any less indebted to groundbreaking work over the last couple of decades in STS and the anthropology of science navigating the peculiarities, specificities and ambivalences of "biocapital" (Franklin 2003; Helmreich 2008; Sunder Rajan 2006; Thompson 2005; Waldby and Mitchell 2006), "biomedicalization" (Clarke et al. 2010; Keating and Cambrosio 2012), and "the vital politics of life itself" (Rose and Rabinow 2006; Rose 2007). Yet, what I find productive in these works is not their descriptions and critiques of things as they are but in the way they address the anxious futurity of all things *bio-*. Researchers have variously referred to the promissory (Cooper 2008), speculative (Sunder Rajan 2006), and conjuring (Tsing 2005) power of entrepreneurial sciences in late capitalism. In biomedicine, these promises, speculations and conjurings attempt to balance the inherent indeterminacy of the future with a need to shape policy decisions, public opinions, and practices of care in the present moment.

Other researchers have done important work reminding us of, what Clarke et al. (2010) call, “countertrends and complications” in biomedical research. Activists, legislators, and community organizations of various stripes have found a number of novel ways to resist, protest and work around being taken in by the optimistic futurity of biomedical research. Sociologist Richard Tutton (2011), for instance, speaks of the importance of “promising pessimism” in bioeconomics, particularly in the context of the “forward-looking statement” that operates as a “particular regulatory instrument of corporate governance in the US and both enables inscriptions of futures and governs those inscriptions according to certain rules of discourse” (2011, 415).

This is where translational medicine becomes such an interesting platform from which to work through the anxious futurity of biomedical cultures. As an approach to funding and practicing research translation points to biomedicine’s acceptance of the need for cross-cultural and multi-mediated, if always imperfect and unequal, connections between experts, private industry, and diverse publics. As anthropologist Carrie Friese has suggested, translational medicine’s feasibility is “linked with its potentiality” (2013). In situating the problem around the need for equitable economic and social benefits, translational medicine points to an inherent contradiction in biomedicine’s future orientation. As Friese puts it:

> ...there is a dilemma regarding the ways futurity operates in bioscience and biomedicine in that promises are made to generate financial and other kinds of

> support for research that, if it is to remain scientifically interesting, cannot seamlessly resolve itself into a therapeutic (2013).

Navigating these contradictions, I've tried to take seriously that translational medicine is first and foremost about multiple and contestable modes of *literal* translation. If done in the way proponents have suggested, translational medicine involves translation across multiple bodies, new technologies, policy contexts, languages and disciplinary perspectives, not to mention public and private interests (Hostiuc et al. 2016; Zerhouni 2004).

The nuances and disjunctures implied by what I call the *multi-translationality* of translational medicine is not lost on the people I've interacted and collaborated with. Many of the researchers and policymakers responsible for promoting translational medicine have nuanced understandings of, for instance, the role of capital in 21st century biomedical research. At the same time, many of them emphasize and embrace the ways in which biomedical translation is multi-mediated, multi-faceted (Jardali 2012) and multi-directional (Marincola 2003; Rubio et al. 2010), requiring cooperation between a range of stakeholders, including non-scientist citizens (Zerhouni 2004). Yet, there seem to be countless examples of attempts to communicate the goals and ambitions of translational medicine that get wrapped up in dated understandings of technoscientific progress informed by unproductive frameworks like deficit models of scientific literacy and linear models of innovation.

In starting from the suggestion that translational medicine is *literally* about translation I want to make clear that translation is an inherently imperfect cultural activity embedded in uneven dynamics of power and knowledge (Foucault 1980; Rabinow 1991). I am struck and confused by translational medicine for the same reasons that translation frustrates people in an array of cultural domains, including the theoretical and methodological preoccupations of STS and cultural anthropology. Translation is an inherently elusive, displacing (Latour 1991, 1996), anxiety-inducing, politically-charged (Venuti 1990) and impossible to fully realize concept and set of practices (Benjamin 1996: 253; Buden 2006). This is true in literature (Delaney 1969), critical literary studies (Venuti 1990) and cybernetics (Weaver 1955) as much as it is true in mathematics (Lubiw and Tanur 2004), philosophy (Benjamin 1923; Derrida 2001) and anthropology (Clifford 1997; Rubel and Rosman 2003; Tsing 1993). Frustrating, sure, but translation in all of these domains is recognized as a core component of relations between humans and other-than-humans in the fostering of meaningful, yet always partial, violent, imperfect and multi-mediated (Haraway 1991; McLuhan 1964; Rubel and Rosman 2003) cross-cultural connections.[35]

Embracing the aforementioned nuances and disjunctures, I still want to use translational medicine as a platform from which to describe, critique and intervene in the collective shaping of biomedical future(s)[36]. The parenthetical plural purposefully points to the ways in which multiple dreams and schemes (Tsing 2005) must be taken into account in any attempt to balance the social and economic risks and gains of biomedical research. Navigating these issues, I argue, benefits from a modest rethinking of notions of scale and deliberation in ethnographic accounts of translational medicine.

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[35] Translation is an inherently cultural activity, one that, if treated in a care-filled manner, can generate what Homi Bhabha calls "hybrid sites of meaning" that "open up a cleavage in the language of culture which suggests that the similitude of the *symbol* as it plays across cultural sites must not obscure the fact that repetition of the *sign* is, in each specific social practice, both different and differential" (1991, 163; emphasis in original).

[36] Though I am using the word in a less technical sense, one could productively think about translational medicine in terms of Keating and Cambrosio's (2003) notion of "biomedical platforms". The authors define biomedical platforms as "material and discursive arrangements that act as the bench upon which conventions concerning the biological or the normal are connected with conventions concerning the medical or pathological" (2003, 4). I am, however, simply referring to translational medicine as the jumping off point for the arguments and interventions that shape this dissertation. In later chapters I address more directly how my work fits into broader arguments concerning the "clinical-biological" strategies that shape 21st century biomedicine, though they will not be directly tied to Keating and Cambrosio's projects in either *Biomedical Platforms* (2003) or *Cancer on Trial* (2012).

It also requires a deeper understanding of the extent to which all forward-looking research presents unique design challenges that only further complicate the social, cultural, economic, political and ethical dimensions of cross-disciplinary research.

Scalar Ambitions

I am curious not just about relationships between local, national and international scales, but also in the relationship between what I call "scalar ambitions" in translational medicine. Scalar ambitions are one way that imagined futures (Beckert 2013) are articulated by individuals and collectives that make up sites of technoscientific research and deliberation. They represent future-oriented movements across scales deemed desirable to researchers, business leaders and other stakeholders involved in particular research endeavours. The research sites, online games and classrooms that make up this dissertation are all shaped by and shaping distinct but often overlapping scalar ambitions. For instance, Keith's emphasis on local students and small scale projects is designed to shape Saint John's future global reputation as a multitasking hub of biomedical innovation. Duncan's emphasis on staying true to the traditional healing practices embedded in the use of cow parsnip quickly ramps up to the goal of eradicating TB around the world.

Scalar ambitions might best be considered a cousin concept to Anna Tsing's "engaged universals." Biomedicine is increasingly characterized by large-scale transnational collaborations between countries with sometimes vastly different frameworks of governance, citizenship and participation (Jasanoff 2003, 2005). At the same time, researchers around the world continue to embrace the rhetorical and practical ambitions of translational medicine. As noted earlier, translational medicine refers to a dynamic set of strategies for more efficiently and expediently transforming basic biological research into clinical and commercial applications, such as diagnostic tools, drugs and other treatment methods. In order to do this, translational researchers want to forge stronger and more dynamic bonds between universities, hospitals, international pharmaceutical and biotechnology companies, and government funding organizations. All of these factors strongly suggest that the 21st century is being defined, in part, by a "biomedicine in the trans-", that needs to be analyzed at the "conjuncture of globalizing, postgenomic biocapital" (Sunder Rajan & Leonell 2013: 467).

Yet, we need to be careful when we talk about globalization and capital-intensive transnational collaborations. We need to emphasize the scale-making processes that make thinking and talking about "globalization" possible in the first place. As Tsing poses the question:

> ...a key issue in assuming a critical perspective on global claims and processes is the making of scales--not just the global but also local and regional scales of all sorts. Through what social and material processes and cultural commitments do localities and globalities come, tentatively, into being (2000, 348).

Tsing recognizes that social mobilization is "based on negotiating more or less recognized differences in the goals, objects, and strategies of the cause. The point of understanding this is not to homogenize perspectives but rather to appreciate how we can use diversity as well as possible" (Tsing 2005, x). Tsing chooses to focus on "zones of awkward engagement" where seemingly incommensurate bodies and ideas attempt to forge connections and mobilize.

At the heart of Tsing's 2005 book, *Friction,* is a concern about how people understand "chains of globalization". As Tsing puts it "globalization at its simplest, encourages dreams of a world in which everything has become part of one single imperial system" (2005, xiii). Tsing highlights the ways in which these "dreams" of globalization are materially manifested in the connections that are forged between her haphazard collection of interlocutors. "Capitalism, science, and politics", Tsing writes, "all depend on universal dreams and schemes" (2005, 1). Truth, for Tsing, is always the result of negotiations with universal aspirations. This serves, for me, as a useful guide for researchers attempting to trace the odd global connections forged in 21st century biomedicine. For Tsing, the universal is neither pure truth or fiction, but a point of connection and collaboration between disparate bodies, entities and institutions. As she puts it, "[a]s soon as we let go of the universal as a self-fulfilling abstract truth, we must become embroiled in specific situations. And thus it is necessary to begin again, in the middle of things" (2005, 2). Thinking about the universal in this way generates some problems for Tsing, in that few scholars have attempted to interrogate the productive aspects of universal aspirations:

> Scholars have not much addressed this question because the idea of the universal suggests abstractions, which turn them away from the practical successes and failures of universals claims. Neither those who place their ideas inside the universal nor those who discredit it as false pause to consider how universals work in a practical sense. To move beyond this it is important to see generalization to the universal as an aspiration, an always unfinished achievement, rather than the confirmation of a preformed law. Then it is possible to notice that universal aspirations must travel across distances and differences, and we can take this travel as an ethnographic object (2005, 7).

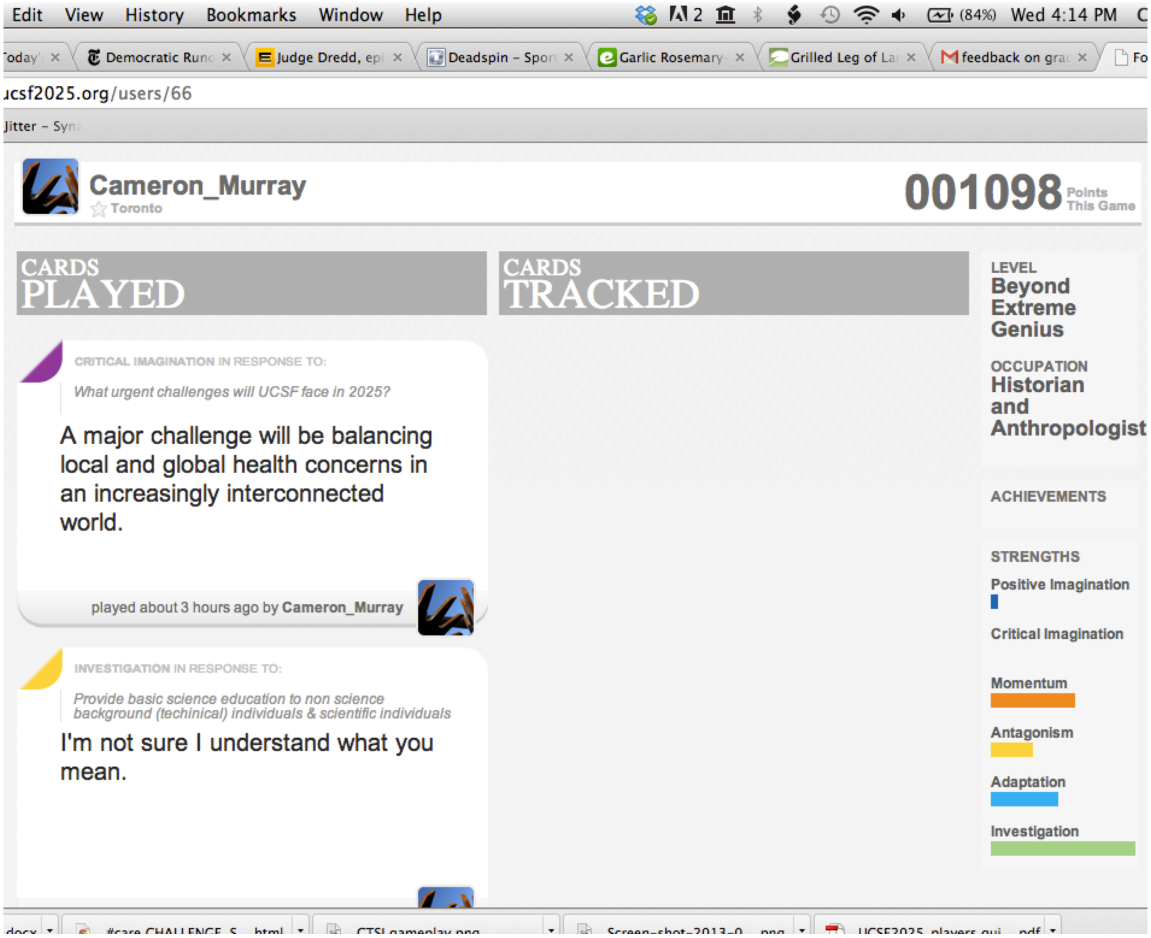
My project takes up a number of universal aspirations. The rhetoric of translational medicine points to aspirations for universal health (Briggle 2012), an aspiration that can only be fulfilled with the right combination of public and private support as well as transdisciplinary and global collaboration. Later, I will deal directly with universal aspirations for "science literacy." These aspirations rub up uneasily against local institutions and lived realities. I share with Tsing an interest in tracing how universal aspirations are taken up in particular locations and how they move across and between a number of scalar domains. As she puts it:

> Universals are effective within particular historical conjunctures that give them content and force. We might specify this conjunctural feature of universals in practice by speaking of engagement. Engaged universals travel across difference and are charged and changed by their travels. Through friction, universals become practically effective. Yet they can never fulfill their promises of universality. Even in transcending localities, they don't take over the world. They are limited by the practical necessity of mobilizing adherents. Engaged universals must convince us to pay attention to them. All universals are engaged when considered as practice projects accomplished in a heterogenous world (2005, 8).

Using translational medicine as a platform, I take up a similar set of questions in an ethnographic text that is broadly concerned with how the changing contours and scales of biomedical research might require new ways of thinking about things like citizenship and participatory democracy. Specifically, I am interested in how the changing frameworks for biomedical research might spark new ways of fostering a "scientifically literate" citizenry that can actively engage in determining how and to what extent new biomedical research projects might impact local, regional, national and transnational communities. If we are going to hold on to the utopian goal of "science for all", as the American Association for the Advancement of Science (AAAS) puts it, we need to couch that goal in a more realistic understanding of the local, regional, national and transnational contexts in which technoscience is practiced and taught. This is especially true if we take seriously the concern that we are moving towards an increasingly risky, volatile and indeterminant technoscientific future.

part 2

FORECASTING BIOMEDICAL FUTURES: DESIGN AND DELIBERATION IN LATE CAPITALISM



ucsf2025.org/users/66

Cameron_Murray
Toronto

001098 Points This Game

CRITICAL IMAGINATION IN RESPONSE TO:

What urgent challenges will UCSF face in 2025?

A major challenge will be balancing local and global health concerns in an increasingly interconnected world.

played about 3 hours ago by **Cameron_Murray**

INVESTIGATION IN RESPONSE TO:

Provide basic science education to non science background (techinical) individuals & scientific individuals

I'm not sure I understand what you mean.

LEVEL
Beyond Extreme Genius

OCCUPATION
Historian and Anthropologist

Figure 5: "The deliberative ethnographer is on the leaderboard," from September 2013. Screenshot by author.

CHAPTER FOUR:

the limits of design

> …despite all the technological and artistic arrangements we make (despite hospital architecture and death-bed design), we do die, just as other mammals die. The word design has managed to retain its key position in everyday discourse because we are starting (perhaps rightly) to lose faith in art and technology as sources of value. Because we are starting to wise up to the design behind them.
>
> - Vilém Flusser, "About the Word Design" (1993)

> First and foremost, it is a design challenge. How do we curate an experience that gets things done?
>
> - Gail Fischer, RDO at UCSF. From field notes.

On September 12, 2013 I became a "Beyond Extreme Genius." This distinction was attained after I participated in *UCSF 2025*, an online game that facilitated transdisciplinary discussions about the future of the University of California San Francisco (UCSF), one of North America's leading biomedical research, training and innovation centers. The game, built by the RAND Corporation's Institute for the Future (IFTF) and using their Foresight Engine gaming platform, asked a seemingly straightforward question: "What if you could map the future of the University of California San Francisco in just 36 hours? What would you put on the map?" An anchoring case study in Part 2 of this dissertation, *UCSF 2025* provides a compelling example of the simultaneously expanding and limiting possibilities of design. The design of *UCSF 2025,* especially its interface and reward structure, both opened up opportunities for anticipatory democracy and deliberative ethnography (Fortun 2012) while seriously limiting the possible futures available to the collective imaginations of participants. *UCSF 2025* is one of two key design events I participated in while working with UCSF Mission Bay. The other was a retreat to finalize strategic design principles for UCSF's Clinical and Translational Science Institute (CTSI). CTSI was in the process of developing proposals for new funding from NIH in 2016 and beyond. Combined, these two events highlight the messy and murky ways through which design is increasingly understood in biomedical innovation. Like translation, design is a concept and set of practices deployed in simultaneously substantive and hollow ways, equally driven by a desire for measurable outcomes and a tool for branding and promotion.

Part 2 of this dissertation combines encounters with design in philosophy (Flusser 1999; Parsons 2015; Sloterdijk 2012; Turner 2018), media studies (Leorke and Wood 2019) and feminist science studies (Allhutter 2012; Rommes, Bath and Maas 2012; Suchman 2009) as well as the increasingly popular role of *experience design* consultants in healthcare, life sciences and community development organizations. With these tools in hand and mind, I extend my interest in situating translational medicine at the intersection of biomedical and entrepreneurial technoscience. As emphasized throughout Part 1, translational medicine has been driven by an increased recognition that biomedical research needs to be flexible, open-ended and collaborative across a number of disciplines, technologies and interest groups. However, overemphasis on discourses of efficiency, expediency and commercial viability can limit how and for what purposes sites and practices of translational medicine have been designed.

In what follows, I narrate digital and in-person fieldwork at UCSF Mission Bay, completed in the summer and fall of 2013.[37] My understanding of design in Part 2 is two-fold. Certainly, design refers to more standard definitions about intentional choices that go into conceiving and building physical and digital environments. However, it equally refers to new ways of understanding and reimagining how consumers

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[37] Some analyses and arguments remain from an initial draft written between 2014 and 2016, but so much of this has been reframed by four years working in design research and strategy. Still, the through line has remained the same since research for Part 2 began oh so long ago: A firm belief that an increased sensitivity to questions of design can enrich the work of anthropologists and STS scholars navigating the inherently unruly and indeterminate physical and digital infrastructures of contemporary biomedical research.

experience products, services and platforms. Since at least the 1970s, social, behavioural and political scientists have traced the emergence of a so-called "post-materialistic society" (Hassenzahl 2013; Inglehart 1971, 1981, 1997, 2018; Kaase and Newton 1995). Experience design is a unique manifestation of post-material capitalism. I argue that both ways of thinking about design are critical in certain frameworks for translational medicine, especially those as concerned with concrete products and outcomes as they are with branding and promotion. My time in Saint John and San Francisco revealed the layered ways in which these two ways of understanding design can be messily deployed in narrating and reaching towards scalar ambitions for the future introduced at the close of Part 1.

Recent years have seen an increased call for "translational designers" who are meant to operate at the intersection of strategic design and healthcare (Norman et al. 2021; Page and John 2019, 2020). These translational designers are charged with helping researchers consider *user* (in this case patients, loved ones and healthcare professionals) needs and experiences when building devices, platforms and services. These designers would be as much concerned with the aesthetic design of products, platforms and environments as they are the overall physical, social and emotional experience of engaging them. These overlapping, if somewhat confusing, layers of design thinking permeated all of my research, but especially my work at UCSF Mission Bay, which is why I have chosen to focus on that site for Part 2.

UCSF Mission Bay

It is a mild and windy morning in July 2013. I am walking (I am always walking) from my hostel in downtown San Francisco to meet Clay Johnston, the president of UCSF's

Clinical and Translational Science Institute (CTSI) at the school's Mission Bay campus. The stroll takes me through colliding social, cultural, political, technological and economic dynamics shaping North America's most expensive and stratified city. Halfway to campus, I am compelled to stop, under a series of overpasses that connect suburbs to the city's downtown and Mission districts. I have never seen so many tents in an urban setting, a complex network of makeshift shelters for the city's ever-present and growing homeless population. Rather than a temporary encampment, one gets an unsettling sense of permanent occupation for many of the people here.[38]

On the other side of the encampment, the landscape starts to shift. Highway overpasses give way to boardwalks and waterfronts. Blown out vacant buildings dissolve into brand new townhouses and condominium complexes. Wide plots of empty land sit right next to the bay. These are surrounded by a network of newly built and under construction research and training facilities that make up the bulk of UCSF Mission Bay. Like in Saint John, I find myself at a critical "in-the-making" moment in UCSF Mission Bay's history. Just a few years after its own ribbon cutting, and very much still a work in progress, UCSF Mission Bay provides a compelling scaled-up contrast to my work in Saint John.

It is by mere yet useful coincidence that research in San Francisco is unfolding in another former shipbuilding hub turned incubator for the hopes and aspirations of biomedical and biotechnological entrepreneurs. Of course, UCSF Mission Bay and close proximity to Silicon Valley make San Francisco a much more established global hub of

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[38] Medical Anthropologist Andrea M. López recently wrote about the peculiar situation for many of San Francisco's unhoused. Using Mbembe's concept of necropolitics, López argues that, in San Francisco, "the urban precariat is governed simultaneously by two logics of intervention that are highly contradictory: compassion and brutality." It is this tension that I was picking up on as I walked through the tent villages in 2013.

biomedical research and innovation than Saint John's DMNB and Brunt Research Lab. Still, it is not lost on me that finding two research sites on opposite coasts sharing comparably rich historic, geographic and economic roots urges a compelling comparison. Two months after this trip, I will be sitting with Keith in a pub down by Saint John's shipping docks while he expresses excitement that I was able to get a "glimmer of our future" by coming to Mission Bay.

Like Saint John, Mission Bay's industrial past was shaped by empire and shipbuilding, with the bay serving as a pivotal gateway to local, regional and global networks of commerce, politics and colonization (Jenkins 2004; Lotchin 1979a, 1979b). Reflecting on this history in a blog post promoting the construction of the new UCSF Mission Bay campus in 2007, Nancy Olmsted, author of *Vanished Waters: A History of San Francisco's Mission Bay*, argued that "Mission Bay once symbolized the soul and spirit of San Francisco, a major portal for shipping and the site of an upstart shipbuilding zone" (para. 24). Olmsted provides an almost too perfect summary of the larger ambitions of UCSF's Mission Bay campus:

> As UCSF continues to lay plans for the creation of a 43-acre research campus at Mission Bay, it is good to remember that the history of Mission Bay mirrors that of San Francisco itself. ***Dreams and schemes*** have been a traditional part of this landscape ever since the 1850s when speculators sold waterlots in Mission Bay in anticipation of the city's growth. The long, slow filling in of this once important waterway cannot now be undone. But...the UCSF Mission Bay campus - and the larger Catellus Development Corporation housing and biotechnology project of which it is a part - should help to end this period of neglect and restore promise and prominence to an area that has served San Franciscans so well (2007, para. 1; emphasis mine).

UCSF Mission Bay might be larger and more well-established than Saint John's DMNB and Brunt Research Lab, but it is driven by the same scalar ambitions and branding strategies. The multi-scalar throughline between these sites is not superficial. It provides a compelling reminder of how quickly microscopic, bit-driven scales of research get pulled across and between local and state level policy decisions. "Ground-breaking" takes on multiple meanings as policy decisions give way to the *design* and construction of new research and training facilities, built alongside modern housing and shopping facilities. Combined, these spaces ground the productive capacities of graduate students, clinician-scientists, representatives from pharmaceutical and biotechnology firms, and university administrators coming to UCSF Mission Bay from around the world. From these grounded positions, ambitions jump more easily from the molecular scales of biological research to the global economic reach of its biomedical and biotechnological translations. In both San Francisco and Saint John, ground-breakings and ribbon cuttings provide literal and figurative foundations on which, what both Nancy Olmsted (2007) and Anna Tsing (2005) describe as, the "dreams and schemes" of biomedical translators can flourish.

Two months before the launch of *UCSF 2025*, I am physically here at UCSF Mission Bay for two reasons: 1.) To conduct an interview with Clay Johnston; and 2.) To participate in a three day retreat focused on CTSI's 2016 NIH funding renewal strategy. What I find most exciting and quasi-subversive is that I came here based solely on an email I received after joining CTSI's mailing list. Rather than over-determine my role as someone hoping to "study" CTSI, I am here as a full fledged participant in the design strategy process.

To be clear, it is not as if I conducted research surreptitiously. I did preliminary work scheduling interviews with CTSI's president, and was very clear with the communication and strategy teams in charge of booking the retreat about my background and research interests. Yet, for both the retreat and *UCSF 2025*, I was given a unique opportunity to just show up and dive in as a participant and an ethnographer. At the retreat, I decided I would let my dual role as researcher *and* contributor reveal itself somewhat organically, while introducing myself to teammates in assigned breakout groups and to anyone I might bump into during meals, cocktail receptions and "networking sessions."

For the most part I was able to stand as *part of* instead of *apart from* these interlocutory collaborators, partly because I blended in as a grad student interested in many of the same questions as my fellow participants. I was determined to build on ideas and to push back when necessary. Rather than study discourses, designs and deliberations, I would actively co-produce them, thus helping to enact the unique contexts (Asdal and Moser 2012) in which the next few chapters unfold. Beyond raw material for my own research interests, I actively contributed to these sessions and offered honest thoughts on what was being proposed. I jumped at a chance to express the productive potential *and* strategic value of STS sensitivities shaping the contours of CTSI's future ambitions.

UCSF and Strategic Foresight

UCSF frames its overall mission as one dedicated to fostering multidisciplinary and collaborative approaches to biomedical research, training and innovation. With no undergraduate students and long established relationships with huge biotechnology and pharmaceutical companies, especially Genentech (Arkin et al. 2014; Rohn 2010), UCSF is uniquely geared towards the efficient, expedient and commercial goals of a particular brand of translational medicine. Perhaps no institution better identifies with translational medicine, if it is defined as a framework for fostering stronger cooperation and collaboration between universities, hospitals, government funding organizations, as well as pharmaceutical and biotechnology companies (Dickler et al., 2006; Page and John 2019; Piqué, Berbegal-Mirabent and Etzkowitz 2020). Not surprisingly, the tensions, contradictions and anxieties generated by blurry distinctions between public and private interests were major topics of discussion in my time at UCSF Mission Bay.

As mentioned, I had initially been invited to participate in *UCSF 2025* and the NIH funding retreat after signing up for CTSI's mailing list. This openness to outside contributions was not surprising given that, in May 2013, Susan Desmond-Hellman, then chancellor of UCSF, gave a TEDMED talk in which she championed a new vision for "breaking down" collaborative barriers to "make a better future" for biomedical innovation. In the talk, Desmond-Hellman called for a new social contract between healthcare providers, researchers, patients and their loved ones, and private pharmaceutical and biotechnology companies. She divided this new social contract into five TED-friendly bullet points:

- Don't underestimate people
- Enable the environment
- Prepare for messiness
- Provide incentives
- Tap into social connections

Part of a process of redefining near and long term future plans, this new social contract was just one example of UCSF's stated commitment to embracing an indeterminate future. Their strategic future forecasts for biomedical innovation were being shaped by an embrace of personalized and precision medicine, where uncertainty and individual needs and experiences drive decision-making (Kimmelman and Tannock 2018; Pyeritz

2020). At the end of her TEDMED talk, fittingly titled “Attention stressed-out docs: Can the consumer be the ‘cavalry’ that rescues you?” Desmond-Hellman posed the following question:

> We have unprecedented ways of connecting big data and science to where patients are….towards precision medicine. Could we make a Google map for health, a more flexible dynamic system that connects patients and their caregivers in fundamentally new ways? (2013).

The CTSI funding retreat and *UCSF 2025* were microcosms of the university’s broader goal of fostering flexible, open-ended and more personalized connections and collaborations between individual patients, a multidisciplinary coterie of researchers and physicians, as well as pharmaceutical and big tech companies that could build dynamic environments and infrastructures to store, share, render and manipulate large quantities of biomedical data.

Layers of design considerations permeated every facet of these initiatives. UCSF wanted current state insight and future state foresight strategies that could help them build a so-called better future, one guided by blurrier borders between biomedical expertise and lived experiences of illness. This was tied to a widely perceived need for systemic shifts from acute to chronic care orientations (Khayal and Farid 2018) that will reshape how healthcare is designed in terms of its products and services as well as the overall experiences of patients, loved ones and healthcare workers (Tsekleves and Cooper 2017).

In 2013, Desmond-Hellman was speaking at the cutting edge of something that has only become more important in subsequent years: the need to address social, cultural and economic factors underlying experiences of chronic disease, an ever-growing epidemic worldwide but especially in the United States (Akyirem et al.

2021; Cockerham, Hamby and Oates 2017). Spaces and places (both physical and digital) of care, from Desmond-Hellman and many others' perspectives, have to be reimagined to accommodate holistic, rather than purely medical, experiences of chronic illness. As a result, everything has to become somehow more personal and more precise, while *also* more flexible and open-ended. As part of these efforts to forecast the future of biomedical innovation, UCSF was holding a wide range of events, hoping to glean insights and strategies from students, researchers, physicians, administrative staff and strategy consultants like IFTF. *UCSF 2025* and the NIH funding retreat were two such events.

Significantly, the emphasis on "openness" in materials promoting these events was in constant tension with the fact that UCSF's broader strategic vision for the future was already more or less set in stone. As a result, a peculiar element of experience design was revealed. UCSF was as concerned with the experiences of their researchers and staff as they were the doctors and patients meant to benefit from their biomedical translations. Within this context, determining what was a legitimate tool for translating research into products, practices and services, and what was merely a strategic branding tool, was nearly impossible.

UCSF CTSI NIH Funding Renewal Retreat

The NIH Funding Renewal Retreat was as much a serious three day in-person strategy workshop as it was a long awaited pat on the back after CTSI's first three years in operation. CTSI was established during the first round of NIH funding for translational research centers in 2009, known as the Clinical and Translational Science Awards

(CTSA).[39] The retreat was thus part promotional vehicle, part critical accounting of past and present challenges and part deep dive into exciting opportunities for CTSI's short and long-term futures. Keynotes were hybrid corporate rallying cries, Apple-aping presentations of new research and TED Talk-ish motivational speeches.

As noted by Clay Johnston, then president of CTSI, in our first interview prior to the retreat, the "real work will unfold during the breakout sessions" that made up the bulk of the retreat's agenda. These sessions were framed, using the language of strategic design, as "ideation and elevation sessions with groups of 8-10 innovators." Each breakout session would focus on one of dozens of precirculated proposals that researchers and administrative staff at CTSI had put forward. Each of these proposals were to provide "novel suggestions for how to redesign CTSI's translational research practices. Key to this is fostering novel collaborations between researchers, community leaders and corporate partners." Having reviewed most of these proposals in the weeks ahead of the retreat, I was struck by the gamut of goals and contexts they ran:

- Discovering the Value of Open Data & Building the Infrastructure to Understand / Use it

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[39] Since 2006 and partially the result of congress's passing of the NIH Reform Act that year, the NIH's Clinical and Translational Science Awards (CTSA) have provided funding and support for almost 60 centers of translational research (Zerhouni 2007). The stated goal of the CTSA is the fostering of a new consortium of individuals, institutions and private companies, who wish to mutually benefit each other by speeding up both the commercialization of biomedical knowledge and the betterment of human health. This has culminated with the recent opening of the NIH's National Center for Advancing Translational Sciences (NCATS) in Bethesda, Maryland. The CTSA is often regarded as an encouraging foundation on which international initiatives in translational medicine have been developed. These international initiatives have gained increased legitimacy thanks to the publication of journals—including *Clinical and Translational Science*, *Journal of Translational Medicine*, and *Science: Translational Medicine*—the development of graduate programs, including combined programs that offer medical and Master of Business Administration (MBA) degrees, alongside the building of expensive "centers," dedicated to the training and housing of translational researchers as well as the dissemination of their work.Generally speaking, CTSA funded projects follow a four-fold model of translation (T1-T4). T1 research involves preclinical studies, often studies conducted on animals. The goal of T1 research is to determine the potential benefits and risks of conducting follow-up studies on human subjects. T2 research involves controlled tests to form the basis for clinical trials. T3 research involves determining how to apply findings in general medical practice. In T4 research, investigators attempt to develop drugs and other treatments that might be beneficial to large populations, with many projects suggesting that the ultimate goal is "improved global health". CTSA institutes are supposed to develop research geared towards specific localized health concerns, while being mindful of the possible benefits to health care facilities, pharmaceutical companies, and communities across the United States and the rest of the world. For instance, the Clinical and Translational Science Institute (CTSI), a joint venture between New York University (NYU) and the New York City Health and Hospitals Corporation (HHC), claims that they want to bring their resources to bear on the health problems facing New York and the nation in the 21st century" (NIH, 2009 Awardees, item 1).

- Grants Program for Collaborative, Multidisciplinary Translational Research
- Administrative Data Concierge Service
- National Repository for Stem Cell Derived Neurons
- Telemedicine and Translational Research
- Harnessing the Law for Translational Science: The UC Initiative on Translational Science and the Law (ITSL)
- Exchange Marketplace for Drug Discovery and Development Resources
- The Global HCV Treatment Revolution: A Response Model for Future Challenges and Opportunities
- Digital Health Sciences Virtual Core
- Bone Health and Fracture Prevention in the Elderly
- Minimizing the CTSI Carbon Footprint
- Translating Neurobiological Knowledge into Psychosocial and Behavioral Interventions That can Prevent and Treat Stress-Related Illness
- Improving and Personalizing the Prevention and Management of Atrial Fibrillation
- Brain on Fire Network
- Precision Medicine Approaches to Diagnosis of Neurodegenerative Disease

These proposals were provided along with login information to a web platform called “The Big Tent: CTSI 2016 NIH Renewal Proposal Launchpad.” The Launchpad allowed participants to “like” and provide comments on proposals they found compelling, provocative and, most importantly, “actionable.” CTSI’s communication and strategy team then pulled the top 10 proposals to be discussed in breakout groups during the in-person retreat. “Top” proposals were determined by the “level of engagement” they inspired on the online Launchpad. The more likes, comments and debates a proposal inspired, the higher it ranked.

From a design perspective, it was immediately apparent that there were strategic limitations placed on what, when, why and how proposals could be presented. As part of the proposal process, submissions had to include answers to three carefully curated questions:

1. How do we maximize impact and broad applicability of the proposal?
2. What foundation exists on campus already that will ensure success of the initiative?
3. What creative and/or innovative partnerships could be leveraged to ensure success?

All of these questions highlight particular ways of defining what translation is and how it works at UCSF's CTSI. Broad applicability, pre-existing foundations and leveraging new and existing partners are all ways to reel in the kinds of proposals made possible. This points again to ways in which, at UCSF's CTSI, as was the case in Saint John, translational medicine is assumed to work best as: a.) research driven by specific healthcare goals and desired commercial outcomes and; b.) an efficient and expedient mobilization of existing knowledge, environments and stakeholders. Though framed around the idea that participants were going to be working at the "cutting edge" to shape "bold and better futures," these questions ensured that the retreat did not radically veer from CTSI's already established strategic goals. At best, the retreat offered what we might call a "veneer of democracy" (Stewart 1985), but was based on predetermined strategies for the future.

Though the breadth of proposals at the CTSI retreat would make fantastic fodder for an entire dissertation project, I want to hone in on one proposal that for me represented a particularly weird combination of superficial, substantive and practical ideas for navigating the discursive, design and deliberative potential of translational medicine: *"Speed-networking" to drive novel translational research connections.*

Biomedical Speed-Dating

"This has to be a joke," I thought to myself when presented with my name tag and designated breakout group. Having made contact with retreat organizers prior to my visit, I thought maybe they were purposefully burying me in a less serious or less proprietarily compromising group. Then I remembered that, in the weeks prior, I had spent much more time commenting on and pondering the "Speed-networking to drive novel translational research connections" proposal than any others. The organizers were likely aware of this and were simply giving those already engaged online a chance to work together in person.

This particular proposal was described as a way to overcome the siloing of academic disciplines and to build better relationships between research, community and corporate partners. Gail Fisher, the then senior manager of the Research Development Office (RDO) at UCSF, drafted the initial proposal. In setting up her pitch, Fisher framed the problem like this:

> Investigators lack opportunities for novel interactions with partners with whom they do not ordinarily collaborate, either because they haven't had the opportunity to meet each other by virtue of operating in different disciplines or locations, or because there has been neither a straight-forward mechanism nor incentive to look outside one's usual circle of partners.

Gail's focus on partnership is important. She emphasized a desire for the team to build an incentive structure that leads to "more intimate interactions down the line." This not so subtle reference to the same stakes at play in speed-dating is key, as Gail wants to champion an understanding of partnership that goes beyond "transactional and contractual obligations." What, she asked, might happen when you accidentally stumble upon someone who shares your values *and* vision, if not your specific disciplinary training or professional preoccupations?

Likening partnerships in translational medicine to intimate interpersonal relationships is less hokey than it might seem. For more than a decade, business and innovation leaders and researchers have used dating as a model and metaphor for collaborative partnerships (Jowitt 2015), especially in the context of design thinking (Serneels, Dams and Jacoby 2018). For some, the language of speed-dating gets in the way of the overall goal of lasting partnerships, exemplified by the title of Locatelli, da Silveira and Mourão's 2018 paper in the *Journal of Business and Industrial Marketing*, "Speed-dating or marriage?" For Gail, however, there is no conflict, because the goal is to give people who might not otherwise meet a chance "to feel a spark." She suggests that these events will be "inclusive and accessible" and:

- Provide an opportunity for scientists to meet research, community, and/or corporate partners outside their usual circle of collaborators in order to foster a broader network partnership through a designated networking event;
- Provide seed-funding for up to three collaborative projects per event in the amount of approximately $5,000 each for feasibility pilot studies that encourage new collaborations, new methods, and/or innovative interdisciplinary research approaches to outstanding translational healthcare issues; and
- Aide in the transition of funded projects to further larger, enabling projects.

What I found so compelling about Gail's proposal was how practical and planned out it was. There was a set timeline, budget and a detailed overview of the specific experiences these networking events were meant to foster. She already had support from the RDO to get started and was hoping the retreat would be a chance to get the first of these off the ground by the fall of 2013. Again, emphasizing the need for expediency, her goal was to "rapidly bring targeted investigators and community, affiliate, and/or commercial partners together and incentivize innovative collaborations."

When I first met Gail at the CTSI retreat, I asked "how exactly would you frame the challenge here?" "First and foremost," she replied, "it is a design challenge. How do we curate an experience that gets things done?" In the initial proposal, the so-called "design challenge" is framed in simultaneously structured and free-wheeling terms, highlighting tensions between curiosity and purpose driven research modalities:

> These "Speed-Networking" events will provide a structured environment in which each researcher will have an opportunity to meet potential outside collaborators in a prescribed format. Additional social interaction time will then allow interested parties an opportunity to continue specific threads of inquiry. Potential partners will ultimately complete a card indicating their interest in speaking further with one or more of the participants. The RDO will manage the follow-up from these events.

To facilitate the collaborative reimagining of CTSI's future, UCSF wanted to kickstart these events within a few months of the retreat. The proposal outlined ten initial events, each with a templated agenda. Individual events would be "themed" and "curated" in alignment with UCSF and CTSI's broader strategic visions. These would help "determine who from the community should be brought to the table." The framing here was much the same as in Saint John, with "community" really only referring to political and business leaders from within a relatively small geographic range. Not to mention that the "table" is a decidedly bloodless metaphor for the exchange of ideas, money and influence, another key indicator that tensions between the hollow and the substantive were as prevalent at UCSF as they were in Saint John.

The Agenda

Combining structured *and* open-ended interactions, these speed-networking/speed-dating events would all follow a single templated agenda. Each event's theme and carefully curated invitees would flesh out, what Gail described during the retreat as, "their meat":

- "Slush" Time (20 min.): the success of this event in part depends on all attendees being punctual; light refreshments, therefore, will be available during this time to allow for casual conversation and serve as "slush" time for stragglers to arrive
- Introduction (5 min.): the RDO team leader will introduce the program, focusing on the intent, format, and financial incentive
- Rotations (1 hr.): four-minute rotations between each set of attendees, allowing all investigators to meet all potential partners around a short set of pre-designed questions (e.g., who, what, what if, and how might we?)
- Free Association (20 min.): people are able to reconnect with a partner with whom there is a "spark" and pursue their shared interest a bit more, potentially developing a more concrete vision of a collaborative project
- Next Steps (10 min.): each attendee will fill out a card identifying her/his top three choices for collaboration; the RDO team leader will close the event by informing participants of next steps and timeline

The events were as much about facilitating new research collaborations as they were raw research and strategy materials *for* the RDO. Though based on "participants' mutual identification of a spark," the RDO themselves would ultimately determine "matches." These matches would then be asked to develop a short proposal outlining the scope of their project, including a pilot study to kick things off. Selected proposals would be given a $5000 budget for their pilot project. Key was to have the proposals completed within 3 weeks of the speed-dating event, a further reminder of the overarching goal of expedient translation.

In the end, "CTSI leadership, with the assistance of the RDO, will make the final funding decision, based on both the likelihood of project success and a fit with CTSI strategic goals." Gail, however, wanted to emphasize that these events are valuable to everyone regardless of whether their pilot projects get off the ground. Each event is itself the "experience" she is hoping to sell to CTSI researchers. As she put it in an overview for our breakout group, "for projects not outlined or funded as a result of this event, it is important to note the tremendous value in the networking component for potential future collaborations and faculty satisfaction." Before leading us in a series of discussions about how to "elevate" her proposal, Gail outlined the three critical "returns on investment" that she thought made this a "win-win" opportunity for the CTSI and UCSF more broadly:

1. The number of researchers that participate in a networking event will be counted;
2. The direct benefit to future collaboration activity made possible by supporting the generation of preliminary data and providing evidence of prior collaboration; this will be measured by following funded projects and capturing the percentage that go on to receive related funding from extramural sources, initiate new contracts, or otherwise move to further the collaboration
3. The participant satisfaction value, which will be measured through a short survey instrument sent at the end of each event.

There is nothing inherently wrong with the framing above. It makes some sense to frame ROIs in blatantly transactional and evidentiary terms. However, what I found frustrating was how much the need to button up these events, to make them fulfill a predetermined agenda set by CTSI's strategic bottom-line, immediately reduced the extent to which, in Gail's words, "a serendipitous spark can change everything." In the end, Gail seemed to assume that emphasizing ubiquitous measurability would somehow guarantee meaningful connections, a uniquely false neoliberal accounting of what and who matters in innovation (Perrin 2002).

Breakout

Our group was slow to get started offering suggestions for Gail's proposal. Just like those attending a real speed-dating event might experience, there was an initial wave of hesitancy, awkward introductions and long pauses. My breakout collaborators were two physicians from a nearby hospital, two members of UCSF's RDO, including Gail, a postdoctoral molecular biologist, an undergraduate bioinformatician and three clinician-scientists from the CTSI. I introduced myself as a "doctoral candidate from Canada with an interest in the history and anthropology of translational medicine." This description itself was strategic, the end result of months of fumbling to introduce myself in emails, phone calls and in-person conversations with potential interlocutors across North America.

After introducing myself, the molecular biologist asked "why would you want to contribute to an event like this? You don't go to school or work here, so why help us plan for grant proposals?" The question was fair and telling, hinting at an assumed competitiveness underlying all academic research. They seemed almost relieved when I acknowledged that this weekend retreat would serve as primary research for my own doctoral degree. The notion of purely selfless participation seemed more jarring than the fact that I was out here for myself first and foremost.

After preliminary introductions, our breakout group began to focus on questions about the speed-dating metaphor Gail was using. A fellow member of the RDO team offered that it seemed like it might diminish the seriousness of these events. Gail replied that it was actually "key" to the seriousness of her proposal, because she wanted these events to be "just as much about feeling like you connect with someone on the specifics as much as on a spiritual level. Partnerships in innovation don't need to look so different from loving relationships." For Gail, this was a way of reframing and reimagining how people learn to work together in biomedical innovation, which she likened to "not so much a fundamental change in research or training" but to a far less easily pinned down "change in the kinds of conversations that shape new and better ideas."

Most of the discussion around refining the proposal had to do with improving the overall experience of the events. For one of the clinician-scientists, an improved experience might come from doubling and tripling down on analogies to dating services. She liked the idea of "speed-dating" events, but wanted to reduce what she called "unnecessary surprises" of blind dating in general. After a guest list is finalized, she thought the RDO should ask everyone attending to set up a "profile page," outlining a few key points about who they are, where they work and what they wanted to get out of the event. She wanted to combine speed-dating with online dating websites. "The risk and excitement is much the same, but you feel at least a little prepared for who you are going to meet." Key to this was getting an early sense of people's "expectations, especially in terms of longer or shorter term commitment," pointing to tensions between a one night stand and lifelong marriage. Another participant elaborated on this point by offering a personal story from her own experiences dating online. "Nothing," she offered "is more frustrating than meeting someone you connect with on every level, only to find out you have wildly different expectations for the future."

There is something profound in considering that commitment phobia might be equally if not more problematic in the contexts of biomedical research and innovation. It was, as she put it, "a major turn off." She continued, suggesting that people should share a "pitch" as part of their profile page:

> Ask participants to record a short video/pitch that can link to their profile…we could call it 'Mission in a minute' or something. You know, who are you, what do you do, and why does it matter? Record pitches, add short videos to your profile and share with everyone before the speed-dating event. (From Field Notes).

Though everyone agreed there was some logic to this, many worried that an opportunity for truly serendipitous sparks might be diminished if the event became overloaded with pre-circulated information and buttoned up pitches.

Emphasis continued to be more and more about the experience of these events, rather than whether and how they might drive better biomedical translations. The bulk of the conversations centered around the venues in which these events would unfold. As one clinician-scientist put it, "this only works if we choose exciting venues that optimize participant experiences." I asked what an "optimized experience looks like in this context." They replied that it was difficult to say, because we had to optimize people's sense of comfort and willingness to share, while also optimizing their sense that something "meaningful and substantive is likely to come out of the event. So, venues have to be cool, comforting and productive." I offered that this sounded like a somewhat meaningless way to describe ideal settings for facilitating collaborative networking. Gail looked at me and said, "good point, and we want to make sure this is all about the end result. Which is exactly why we need high profile champions to draw a crowd."

I continued to push back. "No no," I said, "I think my question is more like 'why do cool venues and high profile participants need to be a part of this at all?'" My goal was not to shoot down the proposal. Rather, I wanted to avoid passively letting the conversation continue without pivoting it in what I saw as a more fruitful direction. It proved to be a useful decision. A postdoctoral fellow offered a clarifying point: "well, don't all of these things matter? They are not mutually exclusive. I think we can push for something cool and exciting, as long as we stay focused on the broader goal of developing helpful research and practices." One of the other clinician-scientists responded with a suggestion that this is where leveraging major biotechnology and pharmaceutical companies, like Genentech and Onyx, who have state of the art facilities on campus, would be "super valuable".

At this point I decided to question a somewhat more foundational concern I had with the proposal. It seemed like, even if these events generated a number of welcomed and unexpected collaborative sparks, there was little chance that truly cutting edge, out of the box thinking would end up receiving seed funding. Taking out my printed copy of the pre-circulated proposal from the Big Tent Launchpad, I read aloud my first comment: "I fail to see how these events will seriously incentivize the kinds of novel connections promised. How likely is it that people will find themselves discussing anything beyond already established paths to funding?" At this point, the tone of the breakout discussions shifted. The question seemed to get to the heart of tensions between public and private interests, and scalar contrasts between the interests and goals of individual translational researchers and UCSF's overall strategic vision.

For Gail and the other RDO staff in our breakout group, my question missed the fundamental point that the events themselves could spark any number of collaborations in the future. "No one," Gail's RDO colleague suggested, "says that people can't meet at these events and then privately and separately come to any number of approaches to working together." This, for many in the group, was reason enough to focus on the overall experience of these speed-dating events as the big selling point. The experience over measurable outcomes was the hook, even if all follow up activities would be explicitly measured against CTSI's established strategic goals, and the extent to which funded projects are able to meet tight deadlines.

In the end, the proposal inspired excitement about the potential for using these events to simultaneously meet the university's strategic vision *and* leave open the possibility for serendipitous sparks of passionate partnership in translational medicine. Speed-dating as a model was itself oddly useful for situating core tensions driving capital-intensive twenty-first century experience economies. The proposal was not so novel, as Gail herself pointed to inspiration from the use of speed-dating as a model for employee recruitment, especially in business, finance and technology sectors. Madalina-Adriana Costin and Mirela Bucurean have pointed out that speed-dating as a model for entrepreneurship "emphasizes first impressions, which may not necessarily be an indication of future collaborations. It is less probable that meeting someone once is enough to bring entrepreneurs profitable business ideas" (2010: 109). However, if the experience itself could be sold as a lasting benefit to attendees, that seemed reason enough to push forward.

Still, I felt as though the underlying notion that the experiential qualities of speed-dating were the main selling point, missed some fundamentally important goals of translational medicine. More than anything, I was worried that there had been almost no in-depth grappling with what translation actually meant to the CTSI, something I was hoping to get out of a follow up interview with Clay Johnston the next day.

The "Feeling of Contribution"

I am sitting in Clay's office, located in a brand new research building, half of which is operated by Genentech, a major biotechnology subsidiary of Roche. As a result, intense security measures were put in place, such that I was only able to enter beyond the front lobby with Clay and a security guard escorting me. On the way up to his twelfth floor office, Clay expressed excitement that I had made the "trip all the way out here to help us out. It sounds like you have a pretty interesting perspective to offer." Clay's sole context for my perspective was gleaned from an email I had sent on July 9, 2013, two weeks prior to the NIH funding retreat.

> *Hello there,*
>
> *My name is Cameron Michael Murray. I am a doctoral candidate from York University, focusing on the history of North American biomedicine. My current work looks at the emergence of translational research institutes in Canada and the United States, and I've been following closely some of the work being done at UCSF. The project seeks not to critique translational medicine, but to contribute novel ways of thinking about the unique local and global challenges faced by this category of research.*
>
> *I received an invite to the Retreat, and promptly RSVP'd. I am also planning to provide a potentially novel proposal, focused on the language and design of translational research, in time for the July 22nd deadline. Anyways, I am very excited about this event, and was wondering if you would have any interest in sitting down for a chat with me about your work, and the UCSF CTSI more broadly, a day or two following the retreat. I have ethics approval for this project, so if you have any interest, I will gladly send over some additional information.*
>
> *Thanks so much for your time,*
> *Cam*
>
> Cameron Michael Murray
> Ph.D Candidate,
> Graduate Program in Science and Technology Studies

To which, I received a prompt reply:

> *Cameron,*
>
> *Glad you can make it and happy to have the proposal.*

> *If we can swing it, I'd be happy to speak with you. Sarah can look at my calendar.*
>
> *Clay*
>
> S. Claiborne Johnston, MD, PhD
> Director, Clinical and Translational Science Institute
> Assoc Vice Chancellor of Research

As we settled into our conversation, Clay was quick to ask how I found the retreat:

> CM: It was super interesting. I am actually a bit surprised that it was so easy for me to be made a part of this.
>
> CJ: We'll take anyone who can help us on our way.
>
> CM: I am impressed by how many of these proposals are trying to address a core problem in translational medicine: how do we bring so many diverse stakeholders together to find common ground?
>
> CJ: Well, yeah, this is clearly the thing on all our minds. But it is probably better if you don't get too bogged down in these proposals. The likelihood that any of these will go beyond this week is slim to none.
>
> CM: What exactly do you mean?
>
> CJ: Well, it is not that we're not going to use them, but we've already produced 80-90% of what we're going to submit to the NIH. So, think of these proposals as offering a lot of little tidbits we can use to bolster proposals already under construction.

Clay was further highlighting tensions between the substantive and performative dimensions of strategic design. I was not so much surprised, but certainly a little frustrated. It immediately became clear why it was so easy to get an invitation to this retreat. It was the performance of the retreat, the positive experiences of participants, that were meant to say something to the world about what UCSF and the CTSI were all about. "Leaving here with that feeling of contribution," Clay offered, "can be just as satisfying as *directly* contributing."

Other aspects of the weekend retreat came into plain view. For instance, upon signing in, we were encouraged to follow the CTSI on Twitter, and were prompted every hour or so with new hashtags we were supposed to help trend online. At the end of the weekend, the most engaging proposals were highlighted on multiple UCSF affiliated websites and social media accounts, and participants in these breakout groups were given gift cards. Our group placed 3rd, with a $25 Amazon gift card for each member. 3rd out of what, why or how, I do not know.

"Oh yeah, I saw that you won," Clay offered, "amazing. Seems worth the trip to me." Rather than dismissive or rude, Clay seemed truly committed to the idea that these events are important, because they help "pad" the university's strategic vision with a keen sense of the needs, experiences and attitudes of its employees. Frustratingly, there is some logic here, but also some hard to embrace principles of post-materialism in this particular context of translational medicine that I was not prepared to deal with.

The Experience of Translation

I began this project wanting to get at the core of what exactly translation is and how it works in biomedicine. It never occurred to me how impossible that task would prove to be. Here, well over halfway through the dissertation, and all I have are extra layers, murkier waters…or choose whatever metaphor you like. What I can say is that tensions between the hollow and the substantive introduced in Part 1 appear tied to much more than the preoccupations and dispositions of individual researchers. Scaling up to the emergence of post-materialist experience economies, we see that what constitutes meaningful versus performative and promotional work is almost impossible to determine in translational medicine. There appears to be a more generalizable shift towards research cultures that are fully invested in the promotional *and* the material consequences of their labour. This presents a uniquely unhelpful position from which to understand translational medicine as a concept, field of inquiry or set of novel practices. Still, I think it is worth staying with the layers of trouble that drive institutions to attempt future forecasts.

In the end, the NIH funding retreat introduced a general sense of unease on my part, especially around the extent to which translational medicine represents both a sincere shift in how biomedical innovation unfolds and a performative promotional gesture towards the emerging values of experience economies. Later I explore how UCSF exacerbates these tensions by showing how both technical and experiential design considerations can severely limit the deliberative potential of futures forecasting. First, however, I want to elaborate more on exactly what I mean by post-materialism and experience economies and how they are shaping the design mentality of translational medicine initiatives at UCSF.

CHAPTER FIVE:

the rise of experience design

> …an episode, a chunk of time that one went through—with sights and sounds, feelings and thoughts, motives and actions […] closely knitted together, stored in memory, labeled, relived, and communicated to others. An experience is a story, emerging from the dialogue of a person with her or his world through action.
>
> - Marc Hassenzahl, *Experience Design: Technology for All the Right Reasons (*2010)

Post-materialism and Experience Design

It is no surprise that a particular design mentality at UCSF's CTSI was emerging at the same time as a massively profitable consulting industry dedicated to the overlapping fields of design thinking, design research, strategic design and user experience design (Page and John 2019). Design consultancies send expensive insight (Martin 2010; Naiman 2019; Slater and Mohr 2006) and foresight (Makridakis 2004; Manu 2006; Rohrbeck, Thom and Arnold 2015) strategy teams, made up of social and behavioural scientists, critical theorists and speculative fiction experts, to develop a wide range of high and low fidelity tools like *UCSF 2025* and the NIH funding retreat. These tools are sources of raw research material *and* meaningful platforms for cross-disciplinary and cross-cultural collaboration. The discussions unfolding inside a game like *UCSF 2025*, for instance, are primary research from which companies like IFTF develop short and long-term design strategies for clients like UCSF. This dual purpose makes it impossible to treat *UCSF 2025* or the NIH funding retreat as merely platforms for deliberating the future of biomedicine. The extent to which they serve this role can only be determined when equal weight is given to their role as tools for strategic design and branding.

The layered ways in which design is deployed as a concept and set of practices here is of critical importance. The shift from materialism to experientialism is a byproduct of unfettered individual and collective wealth and security. As Ronald

Inglehart has been arguing since the 1970s, social groups living through sustained periods of financial and material wealth and security become more explicitly driven by values over accumulated things. Inglehart and others have proposed that post-materialism represents a new model of society, one whose impact will be felt for a long time to come. Writing in the 1990s, Max Kaase and Kenneth Newton noted that a peculiar set of values underlaid these shifts. This was partly due to post-materialistic societies emerging alongside increased secularism in wealthy Western nations. As a result, Kaase and Newton argued that:

> We find substantial support for the model which traces social changes to value changes, and value changes into changes in political attitudes and behaviors, especially through the process of intergenerational replacement….The decline of religious values and the rise of postmaterialist values have transformed the cultural composition of Western democracies in recent decades (1995, 63).

Not surprisingly, the emerging post-materialistic experience society of the 1970s and 1980s was itself decried as “superficial and consumerist” (Hassenzahl 2013) by those attuned to the outsized privilege afforded those for whom consumption was not directly tied to daily survival. Indeed, earlier versions of experience design and marketing directly linked experiences with exclusivity. Buying experiences, in the form of resort vacations, access to club memberships, automobiles, home furnishings, clothing and a wide range of health, wellness and beauty products and services became an explicit act of power, privilege and luxury (Hassenzahl 2013). However, since the 1980s and 1990s, another shift has been taking place, one that makes the experience economy harder to dismiss as a superficial marketing invention. This shift is marked by the aggressive mobilization of social and behavioural scientists to simultaneously shape and solve for the contours of post-materialist design (van Boven 2010).[40]

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[40] Psychologist and neuroscientist Leaf van Boven has been at the forefront of research on the emerging experience economy, focusing on the behaviours and attitudes shaping its values. For van Boven and his colleagues, there is clear evidence that

By the turn of the twenty-first century, scholars and business leaders were publishing books with titles like *The Experience Economy* (Pine and Gilmore, 1999), *The Experience Society* and *Experiential Marketing* (Schmitt 1999). These books addressed the good, bad and otherwise of experiential orientations, but also laid foundations on which an entire consulting industry for experience design and marketing could be built. Tracing the history of experience design, Marc Hassenzahl offers a telling example from *Charlie and the Chocolate Factory*, a 1964 novel and 1971 film produced at the cutting edge of post-materialism:

> But Charlie is poor. It is a freezing winter and the whole family of seven is living on not more than cabbagy meals and the occasional boiled potato. People already offered as much as $500 for the ticket. Wouldn't it be more sensible to forfeit Wonka's frivolous offer and to secure the money? In the end, Charlie took the ticket and was awarded with the most extraordinary experience of his life. Charlie chose the experience over the material. He could have had a winter coat or fire wood instead of the experience, but he already knew that only the visit to the chocolate factory has the power to add some meaning to his life (2013, 2).

For Hassenzahl, *Charlie and the Chocolate Factory* provides an early vision of a still unfolding transformation "into highly individual experience societies…whose members equate happiness with the acquisition of positive life events" (Hassenzahl 2013, 2). Hassenzahl is quick to point out, however, that designing for experiences is more than just "designing for pleasure." It is, rather, a messy, multifaceted and "complex fabric of feelings, thoughts, and actions….I believe emotions and fulfillment of universal psychological needs to have an accentuated role" (2013, 3). Contemporary experience design and marketing contribute to an equally hollow and substantive democratization

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experiential purchases make people happier, both in words expressed and measured responses in the brain (van Boven & Gilovich 2003; van Boven et al. 2010). At the same time, van Boven and colleagues (2010) have uncovered emergent stereotypes specifically tied to whether people perceive their peers to be guided more by materialist or experientialist orientations. In one study, participants characterized people with a "material orientation" as hollow, selfish, insecure and more likely to be judgmental. People with an "experiential orientation" were more likely to be seen as funny, easy to get along with, open-minded, more intelligent, more caring and more gregarious.

of experience economies. Tied less and less to exclusivity and pleasure, public and private organizations are increasingly concerned with how to tap into their customers "where they are." They want to reframe everything, from canned soup to cancer treatments, around the "unmet needs and experiences" of their customers. "Insights" into these needs and experiences are gathered by researchers from social and behavioural sciences, many of whom are taking these positions due to their own survival needs, adapting their expertise beyond the precarious walls of traditional academic vocation.

The agencies that facilitate these multi-purpose experience design considerations are bizarro 21st century descendents of *Mad Men* era advertising firms.[41] In place of static ad copy and images promoting products and services devoid of context, consumers–including and especially consumers of biomedical and biotechnological products, services and environments–are sold experiences. This reflects another way to recognize overlaps between STS scholarship and the goals of the technoscientific innovators we study. An emphasis on experiences represents a shift to an enactment approach to strategic design and planning. It is a recognition that meaning is enacted at particular moments and in particular spaces and places, between diverse stakeholders.[42] In biomedical versions of strategic design, relevant stakeholders whose experiences need to be both "understood and transformed" are healthcare providers, policymakers, patients and their loved ones. These are the same stakeholders enrolled in

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[41] A recent rewatch of the entire *Mad Men* series, combined with four years of my working at one of these agencies, Idea Couture, makes this a lot more than a tongue in cheek analogy. Quite literally, contemporary experience design and marketing agencies are the 21st century equivalent of Madison Avenue advertising firms. The discourses and divisions of labour, the approaches to corporate travel and client engagement at places like Idea Couture are simply progressive, slightly more inclusive, culturalyl diverse and politically correct adaptations of the mid-20th century advertising agency, also brought to life vividly in Don DeLillo's underrated first novel, *Americana*.

[42] Behavioural scientists, anthropologists, sociologists, economists and human-computer interaction scholars have guided both the study and concretization of post-materialist experience societies. They are just as likely to provide theories and warnings about post-materialism's socio-political implications as they are frameworks for taking advantage of emerging value(s) based economies.

contemporary frameworks and roadmaps for successful translational medicine. The goal, as outlined throughout Part 1, is to embrace rather than overcome entanglements of commercial and healthcare outcomes. As a result, there are increased calls, from those operating at the intersection of strategic design and healthcare, for "translational designers" (Norman et al. 2021; Page and John 2019). Rowan Page and Kieran John define these biomedical translational designers as “hybrid design practitioner-researcher who brings the strengths of both industrial design practice and design research as a way to help bridge the chasms between research and commercial development” (2019, 687).

Part 1 tackled these issues by introducing an expansive discursive landscape, with an emphasis on the ways in which translational medicine is rendered simultaneously hollow and concrete. Part 2 is expanding this critique, highlighting empty articulations and dead serious implications of strategic insight and foresight practices shaping translational medicine at UCSF CTSI.

Translational Design

As noted in Part 1, translational medicine necessarily implies translations across a number of fields, languages, technologies, environments, human and other than human bodies, and policy contexts. As a multi-translational domain, this also implies a multi-layered set of design considerations that need to be addressed. Those pushing for experience and human-centered design considerations to be more immediately taken up in translational medicine have pointed to the simultaneously personal and collective design challenges at play. Marie K. Norman and colleagues recently published a study emphasizing the benefits of human-centered design in translational medicine across:

> …five distinct areas: creativity, egalitarianism, structure, efficiency, and visibility. Our data suggest that HCD has the potential to help researchers work more inclusively and collaboratively on interdisciplinary teams and generate more innovative and impactful science (2021, para. 4).

Like Gail at UCSF, researchers are increasingly describing the importance of safe environments that can comfortably accommodate novel collaborations between researchers, patients and loved ones, and clinical practitioners. Moira Clay and colleagues recently conducted a study of the Eureka Institute for Translational Medicine in which they highlighted the multi-scalar tensions at play in building a truly revolutionary foundation on which biological science can be translated. Established in 2007, the Eureka Institute emphasizes how its mission stems from much the same concerns I've been highlighting throughout this dissertation:

> In the early 2000's, translational medicine (TM) had started to become a next research catch-phrase. Everyone said that they were 'doing' TM – but all too often they were merely linking basic research to the clinic, without looking at the whole arc of development as a patient-centric and population-centric activity (Eureka Institute Mission Statement, para. 1).

Eureka operates as a global institute, affiliating itself with nine universities from around the world, though with an emphasis on American institutions:

- Drexel University College of Medicine (USA)
- SingHealth-Duke NUS (Singapore)
- Stanford University Maternal & Child Health Research Institute (USA)
- UMC Utrecht (Netherlands)
- United Arab Emirates University (UAEU)
- University of Arizona (USA)
- University of Miami Clinical & Translational Science Institute (USA)
- University of Toronto (Canada)

The multi-scalar tensions at play are obvious for an institution emphasizing patient-centricity while connecting researchers from around the world. However, they seem to lean into these tensions, emphasizing their goal of "initiating collaborative TM programs that address unmet patient needs. To accomplish this, Eureka leverages its members and coalesce their immense potential into a network with a shared Eurekian vision."

In their study, Clay et al. note the unique ways in which Eureka's design mentality is as much about personal ideas about what translational medicine means to researchers as it is solving global healthcare challenges. This was, in Clay et al.'s understanding, the result of trying to overcome tensions around people aligning themselves with translational medicine out of a sense of fashionable duty:

> This tension compels them to forget about real world needs, and to commit themselves to "fashionable science" in order to secure smooth publication. Many scientists in the biomedical field tend to direct their research toward the elucidation of disease mechanism and discovery of new treatment options. While cure is the ultimate goal for every patient, there are also many other needs associated with improving quality of life that are seldom addressed among researchers of different domains and which someone not spending time with patients cannot fully understand (Clay et. al 2019, para. 2).

Clay et al. are speaking specifically about experience design considerations in translational medicine, the perceived need to build environments, products and services designed for the broader experiences of chronic disease. In this way, translational medicine is less about cures and more about embracing the messy realities of life-long chronic illness. The Eureka Institute, for Clay and their colleagues, is an important example where the seriousness of patient engagement is critical to an overall strategic design vision of the future:

> Groups of esteemed and accomplished scientists have therefore created specific guidelines to establish a new scientific system which will have higher impact on health related issues that really matter to distinct communities. This could mean new promising treatments and/or better quality of life. In order to achieve this, it is important for scientists to strengthen their connections with those whom they plan to serve, such as patient organizations, and to seek out new and non-obvious collaborations among different professionals. It is also essential to change the way research impact and researchers are being measured in order to allocate limited research resources, maximize research benefit and minimize research waste. Finally, in parallel with large scale changes, the most important initiative

> and inevitable step toward shedding the narrow bibliographic mindset is personal introspection of every person regarding their role in this theater that we call science (2019, para. 2).

Human-centered and experience design considerations have become increasingly fundamental to how proponents imagine overcoming what I call the multi-translational challenges of translational medicine. It is, in many ways, an attempt to make translational medicine a serious enterprise, even if a huge chunk of the work that gets done is the facilitation of novel experiences that may or may not have any immediate research value. UCSF's funding retreat and *UCSF 2025* (which I will discuss in detail in the next chapter) are two examples of the potential for experience design to be as hollow as the discourses surrounding translational medicine were in Saint John.

Still, there are reasons to think that treating translational medicine as a unique human-centered design challenge is fruitful. As Marie K. Norman and colleagues have put it, the novelty stems from the ability for experience design to improve collaborations, if done "carefully." They are also quick to point out that this kind of translational experience design is still very much in its infancy:

> HCD is increasingly used in healthcare research to uncover unmet health needs , increase patient trust, design better interventions, and improve hospital space, workflows, processes, and policies. However, the use of HCD to improve collaboration and innovation on scientific research teams is a more recent application (2021, para. 6).

Overall, the last five years has seen an increased assumption that design thinking is the best pathway to building better relationships between researchers and the communities their translations are meant to serve. As Chen, Neta & Roberts have argued, human-centered and experience design are critically important in translational research because they can help "healthcare and public health researchers…develop a common language to improve implementation outcomes and health outcomes for patients and communities" (2021, 1120). The problem is that, much like my concerns with how communities are defined and engaged in Part 1, there are rarely meaningful calls to grant patients and their loved ones decision-making status. They are, even in the most robust frameworks for translational design, still meant to receive imposed upon, expert-driven design strategies. One would hope that the fluidity of experience design would make it that much easier to understand how patients, loved ones and healthcare professionals are just as capable of becoming translational designers.

Experiences as Enactments

Experience design provides another pathway down which to explore overlapping threads of enactment thinking in critical STS and translational medicine. As noted earlier, I am driven by a particular interest in the context-making practices that shape not just the work of biomedical translators, but my own work as well. For me, thinking in terms of enactments is crucial to understanding the conflicting goals of contemporary technoscience. This is because everyone from STS scholars to medical doctors, nurses, patients and their loved ones have embraced a fluid understanding of what, when and where matters in the pursuit and translation of biomedical knowledge. Meaning is enacted in moments of encounter between doctors, researchers, patients and loved ones. Experience design represents a fickle attempt to predict the affective dimensions of these encounters.

Experience design is a transdisciplinary field obsessed with superficial *and* substantial ideas about empathy and meaning-making. As experience designer Marc Hassenzahl and his colleagues have put it:

> After going through an episode, people engage in meaning-making. They literally tell stories to themselves [and others; Baumeister and Newman, 1994]. These

> stories contain the When, Where, and What, detailing a temporal-spatial structure and the content of the experience. In addition, people can tell whether their experience had been positive or negative (i.e., affectivity). Affectivity is a crucial ingredient of experience [Desmet and Hekkert, 2007; Forlizzi and Battarbee, 2004; Hassenzahl, 2010; McCarthy and Wright, 2004]—any experience has an "emotional thread" [McCarthy and Wright, 2004], and it is this affectivity which relates experiences to happiness (Hassenzahl et. al 2013, 22).

It is a similar understanding of meaning-making that I argue inspired the NIH funding retreat and the *UCSF 2025* game design. These were events designed to elicit particular emotions at particular moments rather than particular outcomes. Clay's insistence that the *feeling* of contributing was as important as active contribution is just one telling way of framing where and how experience design distinguishes itself from other areas of design research and thinking. These episodes produce emotional threads that can and should be considered as important as measurable research outcomes.

The problem is that too often *only* these episodic experiences are considered. They are the beginning and end of design considerations, which is just one more way of highlighting the complex ways in which translational medicine can be hollowed out. Emphasizing episodic emotional experiences also reminds us how difficult it can be to shape a substantial role for non-expert publics in making decisions about biomedical translations. If we're always thinking about the future *and* always emphasizing positive experiences in the now, then there is little incentive to pay more than lip service to notions of community engagement and patient-centric decision-making.

Okay, But What is Design?

Significantly, my way of thinking with and through design has been inspired by a weird and wonderful mix of thinkers in media studies, feminist science studies and philosophy. In an essay titled "About the word design", media philosopher Vilém Flusser highlights the fact that "design" is both a noun and a verb. As a noun, design means, among other things, "intention", "plan", "scheme", "aim", "plot", "motif", or "basic structure". As a verb, design might mean "to concoct", "to draft", "to simulate", "to sketch", "to fashion". Flusser believes that design serves as an important material and semiotic bridge over perceived gaps between science, technology and art. As he puts it:

> Hence in contemporary life, *design* more or less indicates the site where art and technology (along with their respective evaluative and scientific ways of thinking) come together as equals, making a new form of culture possible (Flusser 1999, 19)

Generating new and better forms of technoscientific culture has been the goal of many feminist approaches to the history and anthropology of science and medicine. By focusing on the mundane material and semiotic realities of technoscientific labour, feminist science scholars have been particularly interested in cultivating a world where difference and uncertainty are embraced and made productive through *careful* design and embodied practice (Friese 2013; Haraway 1991; Myers 2008; Rommes, Bath and Maas 2012).

For Flusser, the value of an increased sensitivity to questions of design lies in the fact that any culture in which design is recognized as a dominant and dynamic practice would be aware that it is a culture of deception. Designers would know in advance that the lever, for instance, was a form of trickery. As Flusser suggests, an important question emerges in such cultures: "Who and what are we deceiving when we become involved with culture (with art, with technology—in short, with Design)?" (Flusser 1999, 19). Flusser wants to suggest that design can be a very dangerous activity. Design is not inherently good or bad, but it is also not a neutral practice. Designing something, anything, has potentially catastrophic implications.

We can debate whether “deceit” is the most generative word to describe the design of biomedical platforms, products and experiences, but what I take from Flusser’s work is a recognition that design is a motivated activity. In translational medicine, design can be motivated for promotional reasons and profit reasons as much as it can be motivated to generate improved patient outcomes. Sometimes it can be motivated for all of these reasons at once. Remaining sensitive to questions of design is important because, as Peter Sloterdijk has suggested, to be human in the late industrial era is to always exist within mutually designed environments, whether physical or digital. Flusser puts it this way: “That’s the answer then. Everything depends on design” (1999, 21).

I’m not a Flusserian or a Sloterdijkian, and I’m not interested in using philosophy to validate my ethnographic labour. Rather, to paraphrase Kim Fortun, I seek to combine philosophy and ethnography to generate truly novel insights and encounters, in the interest of interrogating the designed spaces and experiences of translational medicine. I am pushing to generate my own understanding of “careful” or “care-*filled”* designs.

PUNCTUM 2:

"I certainly hope so. For world peace."

It is 4:00pm on September 12, 2013. I am six hours into *UCSF 2025* and filled with a mix of excitement and competitive anxiety, forced to see an ever-shifting leaderboard on the top right of the game's homepage and dashboard. We are playing for bragging rights and gift cards, apparently enough to suppress that part of me that might otherwise place this firmly in the "has little real world consequences" folder in my brain. I have been carefully navigating my role as digital ethnographer and active participant, using what I consider a unique identity to set up ongoing deliberations with UCSF staff, students, researchers and administrators. Emphasizing my interest in the "history and anthropology of translational medicine" seems to pique enough interest that I've sustained near constant game play since we launched at 10:00am EST. The game will continue until 10:00pm the following night, at which point I will finally get some rest. It is hard to overstate the addictive aspects of *UCSF 2025*, one which combines role playing, cards and social media within a reward structure that makes constant engagement the only way to win. Something akin to the "machine zone"(Schüll 2012) took over, a situation where I wasn't playing to win necessarily, but simply for the sake of playing throughout the entire 36 hour stretch of the game .

Six hours in and I have been pleased with the richness of my conversations with fellow participants, especially around the social, ethical and political consequences of overly commercial interpretations of translational medicine. However, one participant in particular has been on the receiving end of a number of my responses and provocations. Like in Part 1, the punctum here stems from off the cuff comments that left me feeling more than a little gutted that the social, cultural and political contexts and consequences of technoscience remain out of view for many. Rather than being dismissive, I treated this as an opportunity to experiment with layering STS infused thinking within a series of conversations with this fellow participant, a surgeon named Sushil. Part way through the first day of game play, I began engaging in a long debate about global health interventions with Sushil, a conversation we picked back up a number of times during the 36 hours of endless game play offered by *UCSF 2025*. My conversations with Sushil highlight the potential of a deliberative ethnographic approach, while also revealing limits inherent to *UCSF 2025*'s design and reward structure.

The moment that pricked me most came early in the game, as Sushil was summarizing his vision for translating global clinical research:

> S: UCSF should look at research from the developing world as rich clinical material and non-conventional methods can throw up new ideas.
>
> C: What about a consideration of how that research is being conducted? Ethical challenges, and influence from American/European funding bodies?
>
> S: Let each country set ethical standards for research rather than try to force a global model. Ethics is regional; human data is universal.
>
> C: I'm not pushing a global model. I'm saying that a consideration of how data is collected in particular contexts is important.
>
> S: Yes, I agree that there are ethical standards that are global too and these must be met at all costs.
>
> C: But doesn't that trouble the claim that human data is "universal"? I'm not trying to push the issue, just wondering what you meant by that?
>
> S: What is ethical in one culture may not be in another. Science applies to all.
>
> A: Still, there may be limits?

> S: With the global culture of today barriers to mutual understanding are breaking down. A world ethic should emerge.
>
> C: This is a very troubling perspective.
>
> S: Not really. With global connectedness, in the next few decades all cultures should develop a world culture and ethic acceptable to all.
>
> C: So, you're suggesting there can be a single "world culture" and universal ethical guidelines?
>
> S: I sincerely hope so. For world peace.

What I found so frustrating was the fact that there seemed to be no way to adequately express, in 140 or fewer characters, my desire to challenge, if not change, Sushil's point of view. I wanted at least to add depth and sensitivity to his desire to universalize biomedical research ethics. Of course, he was not being willfully obtuse, and was doing a better job than I was making contributions that aligned with the bite-sized, Twitter-length, techno-utopian sloganeering preferred by *UCSF 2025*'s platform. Yet, throughout our conversations, I felt compelled to press, on the off-chance that I might bring STS to bear on my discussions with Sushil and others. Like my conversation with the director of ethics in Ottawa, the biggest challenge seemed to be finding common ground on which to walk and talk together.

What limited us more than anything, I argue, is the overall design of *UCSF 2025* as both an experience and a digital platform. Like the NIH funding retreat with CTSI, the game was as much a branding exercise as a substantive attempt to forecast the future of biomedical research. That was made most apparent in the ways in which the game's designed environments and gameplay features reeled in rather than expanded the narrative possibilities available to participants. This aligns with core tensions between open and closed worlds in experience design (Bakırlıoğlu & Kohtala 2019; Islind et al. 2019).

UCSF 2025

UCSF 2025 was built by the Institute for the Future (IFTF), an offshoot of the RAND corporation. Founded in the late 1960s, IFTF was initially guided by a belief that "the right methodology would allow them not only to solve pressing social problems, but to forecast the future'" (1998 IFTF promotional brochure). Though its early focus was academic and government advising, the IFTF was quick to extend services to corporate clients (Candy 2018; Dunagan 2012; Ramos, Mansfield and Priday 2012). One of IFTF's main functions, especially in the last two decades, has been helping companies and public institutions develop ludic approaches to working through anxieties and desires for the future. In ludic forms of work and play, people engage in semi-guided modes of play and collaboration (Rosa and Sweeney 2019; Tonkin 2019). Brooks & Bowker suggest that clients expect IFTF to "create 'playgrounds' for visionary practice while also articulating a sociology of future work practices" (2002: 124). Indeed, proponents of games like *UCSF 2025*, emphasize how they showcase a "collective capacity" (Candy 2018) supposedly unique to humans: to worry about and shape our collective futures (Slaughter 1996, 2002). Though less robust, I argue that the CTSI funding retreat is cut from the same ludic cloth. Both the retreat and *UCSF 2025* are part of a broader UCSF desire to achieve its strategic vision for the future. These events offer some sincere opportunities for tapping into "collective capacities" of researchers, clinicians and students, but are equally used as branding and promotional materials regardless of whether meaningful outcomes are the result.

The Foresight Engine gaming platform is an example of IFTF's increased interest in generating "online playgrounds" that allow for local, national and international modes of collaborative foresight. The platform, according to IFTF, engages "various publics in rapid conversation about pressing issues of the future, using basic game dynamics to make it fun and to encourage participation." The Foresight Engine has been built from a relatively modest and minimalistic design strategy. It is easy to navigate and has been inspired by the open and flexible spaces of collaborative work that have been mainstays of large technology companies in Silicon Valley. The design has also been inspired by the ubiquity of social networking platforms, especially Twitter. The conversations participants have within Foresight Engine games are generated by their posting and building upon digital "cards" that the company calls "Twitter-length micro-forecasts that players can build on by agreeing or disagreeing, or expanding on by taking them in new directions."

Foresight Engine has been used to build games for a number of clients, including the US Navy, the Myelin Repair Foundation, the City of Christchurch, and the Rockefeller Foundation. Though clients can control who will have access to the games, and ultimately how much they wish to publicize outcomes and findings, IFTF is the sole owner of the Foresight Engine platform. They tweak each game to suit the goals of their client, but they all unfold in a very similar manner. *UCSF 2025* is described by IFTF as a "bottom-up, grassroots effort to generate transformative ideas about the future of health sciences research and education—to create a new map of UCSF in 2025" (para. 3) and was played in four steps.

STEP 1: Watch the video.

In a video that participants watch before entering the *UCSF 2025* game environment, a fictional account of what a “Google map for health” might look like is used to inspire the creativity of game participants. The video is meant to help viewers “immerse in the future of education, health and research. See what the drivers of change are. Imagine what new opportunities might emerge for UCSF. Consider: Given these transformations, what if you could map the future of UCSF?”

STEP 2: Play your cards.

Players are given the option of playing either “Positive Imagination” or “Critical Imagination” cards. Positive cards serve as descriptions of how UCSF will be able to “lead the way” in 2025. Critical cards highlight potential challenges that UCSF will need to consider before moving forward with particular initiatives. Cards amount to 140 character “micro-contributions.” Participants are encouraged to post as many cards as they would like and are reminded that the “more you play, the more people you can engage around the world. And the more people you engage with your ideas, the more points you win.”

STEP 3: Build on other players’ cards.

When anyone posts a positive or critical imagination card, other participants are encouraged to respond to them, in the hopes of setting up rich and sustained conversations with multiple players. These cards remain open for the duration of the game, so participants can respond to cards as they get posted, or can reignite earlier conversations whenever they’d like. There are four kinds of cards that can be used for “building”:

Momentum: If you agree, what is the next step to getting an initiative off the ground?

Antagonism: If you disagree, what do you think should happen instead?

Adaptation: If you agree but want to consider the possible evolution of an initiative overtime

Investigation: If you’re confused or curious, ask a follow-up question.

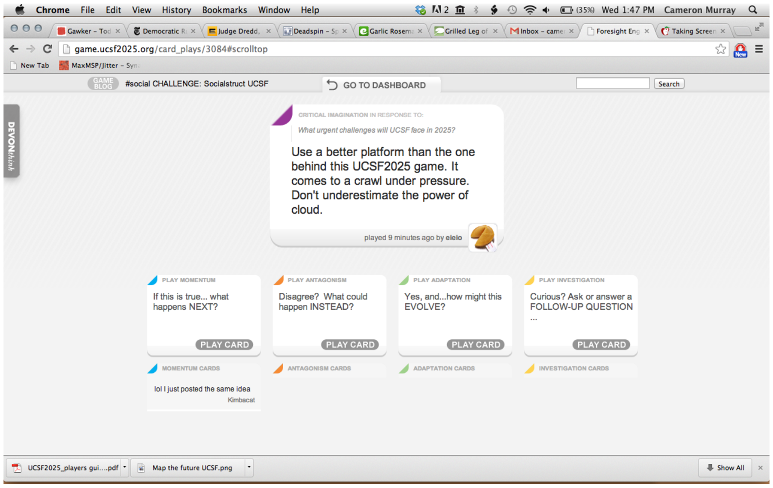
Building on other player’s cards is the most important component of the game, and is described by organizers as:

> “…the best way to build points—and deepen the conversation about the future of UCSF! When someone builds on one of your cards, you automatically win points without doing anything. When you build

> > on other’s cards, you start a card chain and encourage others to build on your cards. The longer the chains, the more points you win! And the more you foster meaningful discussion about UCSF and its place in the world.”

> *STEP 4: Watch the game live on the dashboard.*
>
> Players are encouraged to return to the dashboard frequently to see what topics are trending, and what ideas seem to be gaining the most momentum. The dashboard also includes the leaderboard, so players can keep track of how they are doing overall. The dashboard is divided into three separate sections, each giving players a slightly different perspective on how the game is unfolding. One page let’s you keep track of the most recent cards played, including the most recent builds on your own cards. New cards are labeled with a specific colour for positive or critical imagination (dark blue for positive imagination, purple for critical imagination). Each card also includes the username of the player as well as an up-to-date account of how many points a particular card has generated. Down the right hand side, you can track your position on the official leaderboard, as well as a list of trending hashtags. Other dashboard views include cards that game moderators have determined to be “super interesting”, as well as build cards that generated more than 100 points. A third page indicates the players with the most points earned, the players that were most followed by other participants, cards that were considered “Most Super Interesting”, as well as an up-to-date list of players who just recently entered the game and placed their first cards. Clicking on a participant’s name takes you to a profile page that gives you their occupation, their city or country of residence, their rank and overall position in the game.

Participants included USCF students, alumni, faculty and administrative staff. 4% of participants were UCSF donors and 5% were unaffiliated members of other institutions or the general public. In total, we collectively generated 24 711 micro-contributions. These ran the gamut of big picture ideas for revolutionary biomedical research infrastructures to more mundane concerns about university administration and parking. Not surprisingly, some participants used their cards to actively criticize the Foresight Engine platform itself.



#social CHALLENGE: Socialstruct UCSF

CRITICAL IMAGINATION IN RESPONSE TO:

What urgent challenges will UCSF face in 2025?

Use a better platform than the one behind this UCSF2025 game. It comes to a crawl under pressure. Don't underestimate the power of cloud.

played 9 minutes ago by **elelo**

If this is true... what happens NEXT?

Disagree? What could happen INSTEAD?

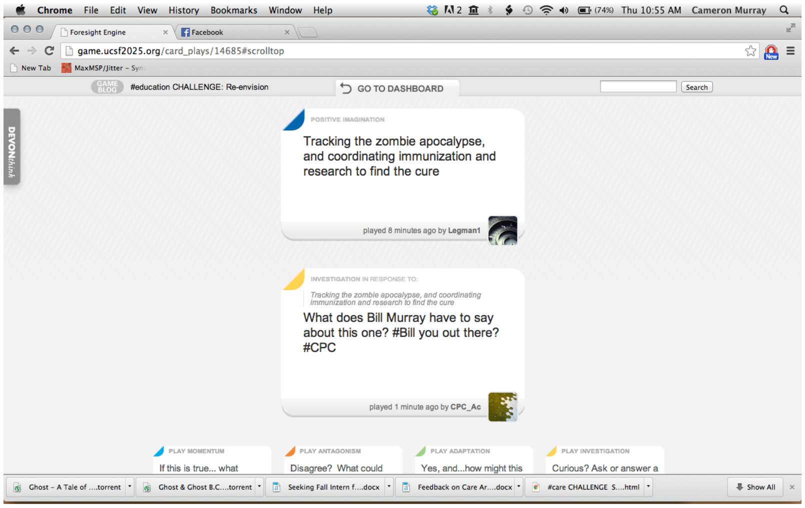
Yes, and...how might this EVOLVE?

Curious? Ask or answer a FOLLOW-UP QUESTION ...

lol I just posted the same idea
Kimbacat

Figure 6: “Use a better platform.” Screenshot by author.

And there were at least a few participants who used their time offering frivolous and irrelevant, though I’ll admit pretty funny suggestions.



#education CHALLENGE: Re-envision

POSITIVE IMAGINATION

Tracking the zombie apocalypse, and coordinating immunization and research to find the cure

played 8 minutes ago by **Legman1**

INVESTIGATION IN RESPONSE TO:

Tracking the zombie apocalypse, and coordinating immunization and research to find the cure

What does Bill Murray have to say about this one? #Bill you out there? #CPC

played 1 minute ago by **CPC_Ac**

If this is true... what

Disagree? What could

Yes, and...how might this

Curious? Ask or answer a

Figure 7: “Tracking zombies.” Screenshot by author.

Deliberative Ethnography and Anticipatory Democracy

Most importantly, *UCSF 2025* revealed to me the desires and anxieties of a wide range of biomedical workers. Like many of my colleagues in STS and related disciplines, biomedical researchers are anxious about the increased corporatization of research, medical practice and higher education more broadly (McHenry 2008). At the same time, they too take seriously the productive potential of embracing uncertainty and complexity in their research. They're increasingly aligning themselves with the multiple and sometimes conflicting scalar ambitions of translational and personalized medicine, in the hopes of accounting for individual distinctions that make broad generalizations less and less helpful or desirable. They understand inherent contradictions and tensions generated by rhetorics of openness and flexibility within a research context increasingly blurring boundaries between public and private interests. With all this in mind, it became clear how unproductive it would be to simply monitor *UCSF 2025*, generating little more than a descriptive ethnography of biomedical researchers forecasting their futures. Their concerns matched mine, and inspired me to provoke, collaborate and contest the cards being played.

The IFTF's Foresight Engine has been described as a platform that facilitates what has come to be called anticipatory democracy. Anticipatory democracy entails the design of virtual and physical infrastructures and experiences that support the "sustained transformational power that can be mustered by a motivated society – legislature, government apparatus and citizenry – engaged in a mutual vision of a desired, achievable future. " (Ramos, Mansfield & Priday 2012: 72). Stuart Candy has traced how games like *UCSF 2025* are part of a much broader history of attempts to use speculative fiction to shape collective futures and new models of democracy:

> Richard Slaughter has described such a collective capacity as 'foresight culture' or 'social foresight' (Slaughter, 1996, 2002), echoing Alvin Toffler's outline of 'social futurism' and 'anticipatory democracy' a generation earlier (Toffler, 1970), and amplifying an argument made decades before that by none other than H. G. Wells, calling for professors, and indeed a profession, of foresight: "All these new things, these new inventions and new powers, come crowding along; every one is fraught with consequences, and yet it is only after something has hit us hard that we set about dealing with it" [Wells, 1989, pp. 3–4] (Candy 2018, 237).

As part of this historic lineage of speculative foresight cultures, Ramos, Mansfield and Priday have argued that the Foresight Engine is one of a number of recent platforms that represent a “global successor to A[nticipatory] D[emocracy]” (2012, 73), one that is richer and more embedded in today’s digital, global and networked media landscape.

Again, a deliberative approach to ethnography can move us from the labour of description to provocation. The future orientation of deliberative ethnography is particularly useful in the context of a forecasting game like *UCSF 2025* because, as Kim Fortun puts it, ethnographers are “trained and positioned, funnily, to tolerate the unknown; we have an affordance for unimaginable futures” (2013, 458). The design of *UCSF 2025* allowed me to critically engage, provoke and, using the somewhat unfortunate language of the game itself, “antagonize” my interlocutors, the majority of whom were researchers, administrators, physicians and students directly affiliated with UCSF. This included attempts to generate threads of debate concerning the value of biomedical researchers opening up to collaborating with historians, anthropologists and sociologists of science and medicine. I actively identified as someone studying the history and anthropology of translational medicine and the biomedical sciences more broadly. Some encounters were more productive than others, but ultimately the experience was an interesting case study in the potential value of a deliberative approach to ethnographic research in a dynamic digital space.

Our Collective Biomedical Future(s)

UCSF 2025 organizers were, more than anything, pushing the idea that we were all, regardless of cultural or disciplinary backgrounds and preoccupations, in this together. There was a collective sense of urgency in some of the discussions that made it possible to excite people with ideas that might be taken for granted at, for instance, an STS conference. It was *our*, not their or my, future that needed to be forecasted, and that made my approach to engaging fellow participants feel particularly constructive.

Early on in the game, I felt compelled to spearhead my own threads of discussion, using taken for granted notions of scale-making and technoscience from STS and seeing how researchers, physicians and administrators tackled them. It was an attempt to see if I could, in 140 or fewer characters, *translate* the value of STS thinking into the forecasting of biomedical futures. Instead of assuming that participants were well versed in popular figures and terminologies in STS, I had to distill concepts to their most useful conversational essences. This is a worthwhile practice for anyone hoping to pull niche academic expertise into public domains.

First and foremost, I felt compelled to articulate my concern with relationships across and between the scales at play in biomedical research, without getting into the weeds around debates about what scales are and how they function in technoscientific innovation. To get people engaged, they had to immediately recognize an intrinsic value in what I was saying.

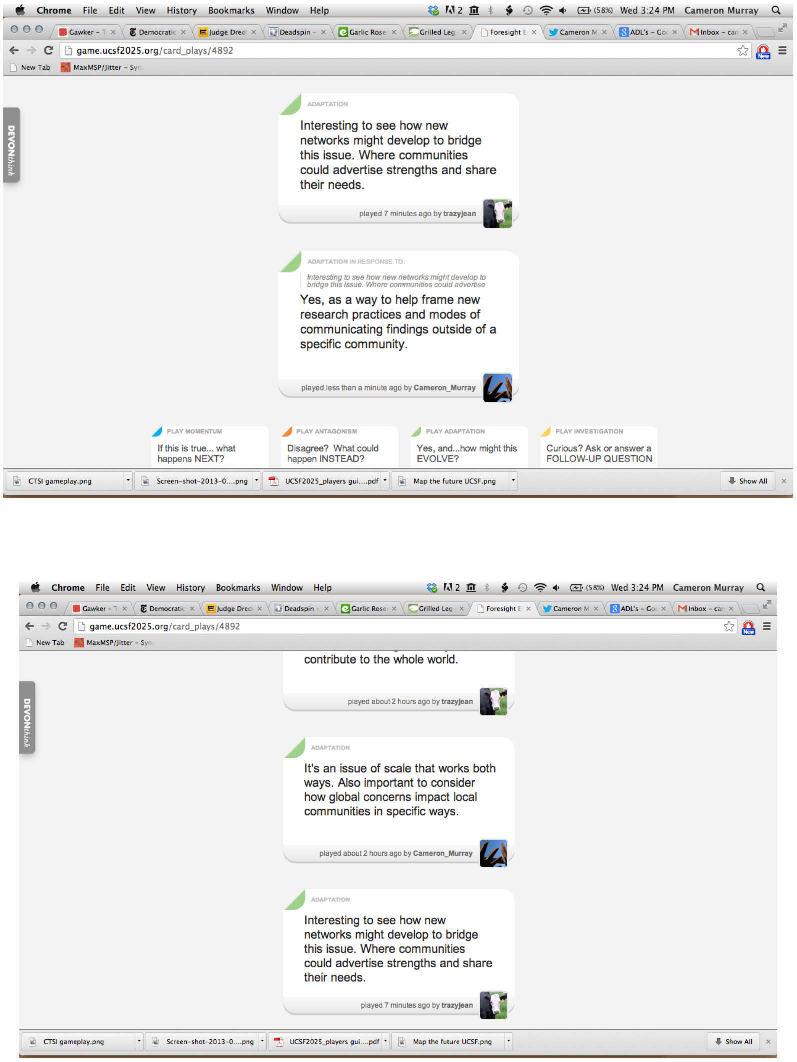
CRITICAL IMAGINATION

A major challenge will be balancing local and global health concerns in an increasingly interconnected world.

played about 2 hours ago by Cameron_Murray

ADAPTATION

Will hopefully draw our attention to maximizing our unique regional/local assets and seeing how they can contribute to the whole world.



ADAPTATION

Interesting to see how new networks might develop to bridge this issue. Where communities could advertise strengths and share their needs.

played 7 minutes ago by **trazyjean**

ADAPTATION IN RESPONSE TO:

Interesting to see how new networks might develop to bridge this issue. Where communities could advertise

Yes, as a way to help frame new research practices and modes of communicating findings outside of a specific community.

played less than a minute ago by **Cameron_Murray**

PLAY MOMENTUM
If this is true... what happens NEXT?

PLAY ANTAGONISM
Disagree? What could happen INSTEAD?

PLAY ADAPTATION
Yes, and...how might this EVOLVE?

PLAY INVESTIGATION
Curious? Ask or answer a FOLLOW-UP QUESTION

contribute to the whole world.

played about 2 hours ago by **trazyjean**

ADAPTATION

It's an issue of scale that works both ways. Also important to consider how global concerns impact local communities in specific ways.

played about 2 hours ago by **Cameron_Murray**

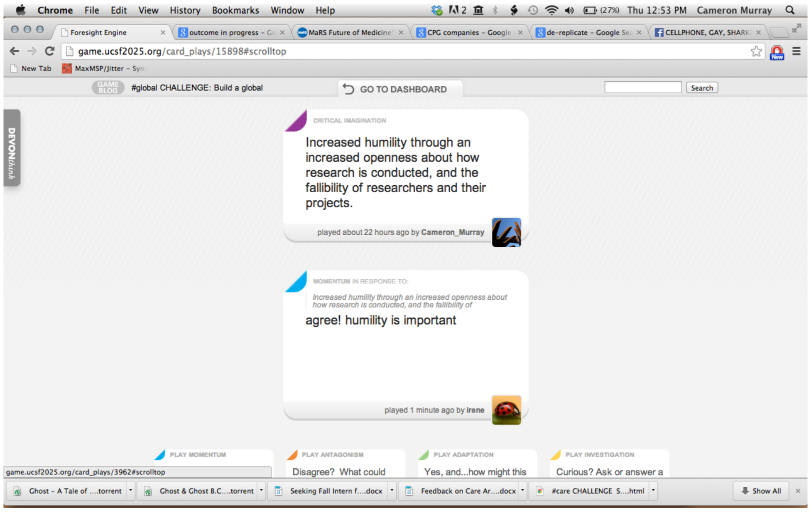
ADAPTATION

Interesting to see how new networks might develop to bridge this issue. Where communities could advertise strengths and share their needs.

played 7 minutes ago by **trazyjean**

Figures 8, 9, 10: “Scaling the Stage.” Screenshot by author.

Still, my biggest early hurdle was turning piles of hollow posts into sustained conversations. The character limit and environment imposed by *UCSF 2025* made it incredibly difficult for back and forth, mutually engaging conversations. Everyone, especially in the first few hours of gameplay, seemed committed to TED Talk style talking points, a particular brand of communication that tries to make short posts so catchy and self-confirming that they “say it all” (di Carlo 2014). How, I wondered, was I supposed to communicate the substance of critical STS terms and ways of thinking without making them feel like pitch deck slogans?



CRITICAL IMAGINATION

Increased humility through an increased openness about how research is conducted, and the fallibility of researchers and their projects.

played about 22 hours ago by **Cameron_Murray**

MOMENTUM IN RESPONSE TO:

Increased humility through an increased openness about how research is conducted, and the fallibility of

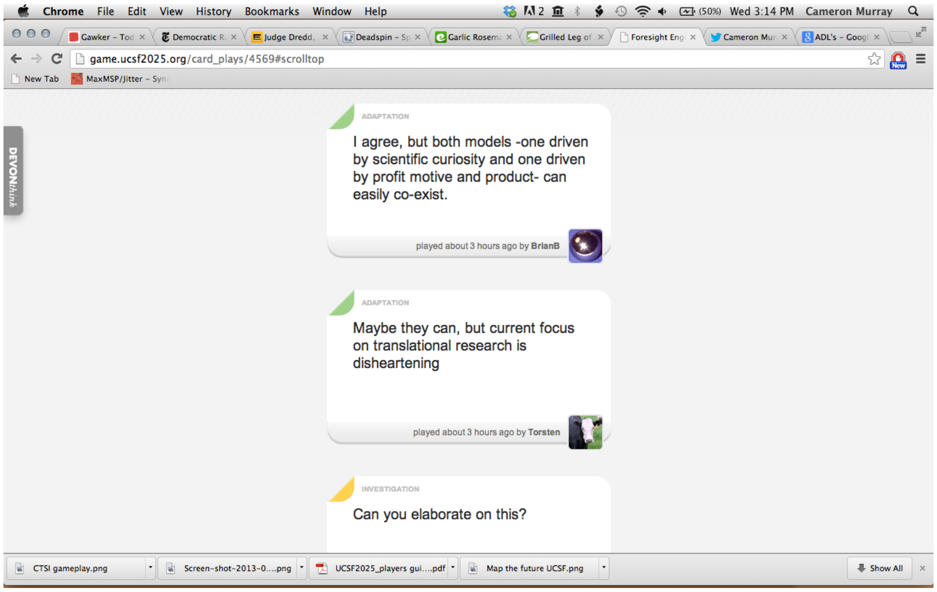
agree! humility is important

played 1 minute ago by **irene**

Figure 11: "Rigorous Humility." Screenshot by author.

No, really, what is translational medicine?

One of my biggest challenges had to do with the ways in which translational medicine was being discussed in *UCSF 2025*. As noted in Part 1, I had come to this research with a well worn frustration with the concept, how it had been defined and the narrow ways in which many proponents understood how it should work in practice. Like in Saint John, I was equally excited and frustrated by the ways in which UCSF's biomedical researchers understood translation. For the most part, people seemed concerned with how translational medicine was pitting curiosity and profit driven modes of research against one another. There was an ingrained assumption that these were mutually exclusive. However, the frameworks provided all seemed too convenient, tied again to an assumed need to engage with the discourses of translational medicine *as* commercialized medicine.



ADAPTATION

I agree, but both models -one driven by scientific curiosity and one driven by profit motive and product- can easily co-exist.

played about 3 hours ago by **BrianB**

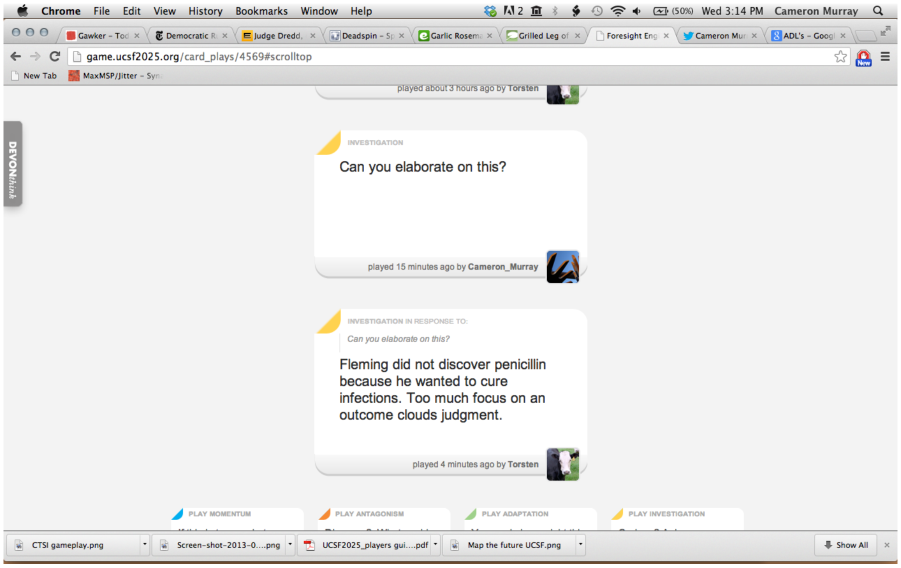
ADAPTATION

Maybe they can, but current focus on translational research is disheartening

played about 3 hours ago by **Torsten**

INVESTIGATION

Can you elaborate on this?



played about 3 hours ago by **Torsten**

INVESTIGATION

Can you elaborate on this?

played 15 minutes ago by **Cameron_Murray**

INVESTIGATION IN RESPONSE TO:

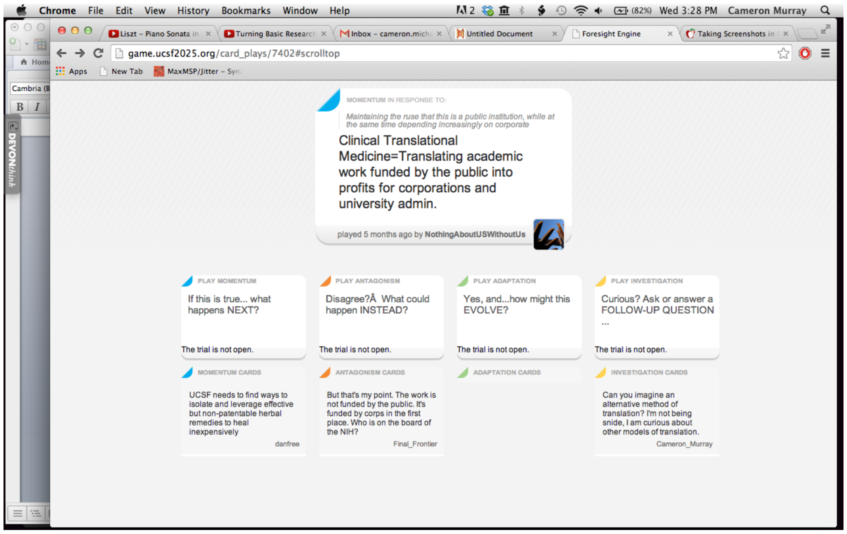
Can you elaborate on this?

Fleming did not discover penicillin because he wanted to cure infections. Too much focus on an outcome clouds judgment.

played 4 minutes ago by **Torsten**

Figures 12 and 13: "What is translational medicine?" Screenshot by author.

In my conversation with a user named "Torsten" above, the biggest challenge had to do with navigating the provided categories of response cards. I was not necessarily interested in momentum, antagonism, adaptation *or* investigation, but rather in sitting with the same question that shaped the very beginning of my research: "what is translational medicine?" However, there was no way to ask this question in 140 or fewer characters without getting a sense that people on the other side were rolling their eyes at me. There was a taken for granted understanding that translational medicine *was* commercialization, and the only thing left to determine was whether one was for or against this basic fact. Yet, I had already witnessed many options for how translation might be defined and practiced in biomedicine–Duncan and Chris in Saint John being the most obvious examples–such that I wanted to find ways to pivot discussions to richer engagement with the word itself.



MOMENTUM IN RESPONSE TO:

Maintaining the ruse that this is a public institution, while at the same time depending increasingly on corporate

Clinical Translational Medicine=Translating academic work funded by the public into profits for corporations and university admin.

played 5 months ago by **NothingAboutUSWithoutUs**

PLAY MOMENTUM

If this is true... what happens NEXT?

The trial is not open.

PLAY ANTAGONISM

Disagree?Â What could happen INSTEAD?

The trial is not open.

PLAY ADAPTATION

Yes, and...how might this EVOLVE?

The trial is not open.

PLAY INVESTIGATION

Curious? Ask or answer a FOLLOW-UP QUESTION ...

The trial is not open.

MOMENTUM CARDS

UCSF needs to find ways to isolate and leverage effective but non-patentable herbal remedies to heal inexpensively

danfree

ANTAGONISM CARDS

But that's my point. The work is not funded by the public. It's funded by corps in the first place. Who is on the board of the NIH?

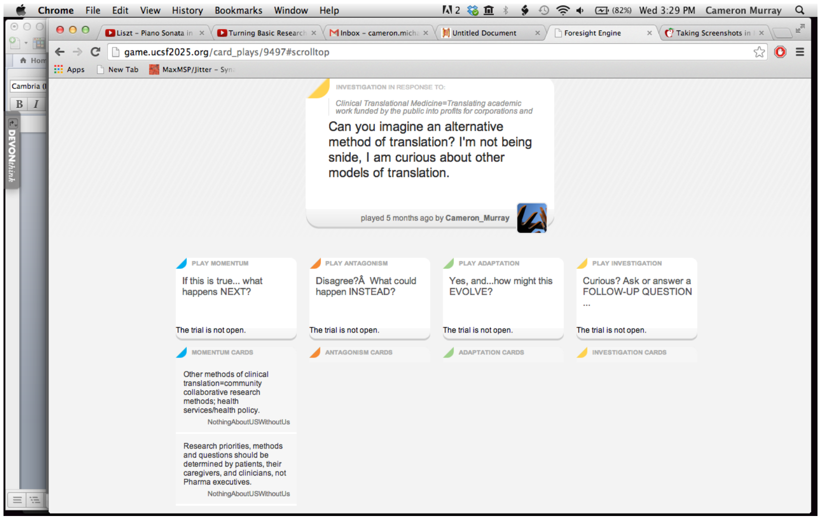
Final_Frontier

ADAPTATION CARDS

INVESTIGATION CARDS

Can you imagine an alternative method of translation? I'm not being snide, I am curious about other models of translation.

Cameron_Murray



INVESTIGATION IN RESPONSE TO:

Clinical Translational Medicine=Translating academic work funded by the public into profits for corporations and

Can you imagine an alternative method of translation? I'm not being snide, I am curious about other models of translation.

played 5 months ago by **Cameron_Murray**

PLAY MOMENTUM

If this is true... what happens NEXT?

The trial is not open.

PLAY ANTAGONISM

Disagree?Â What could happen INSTEAD?

The trial is not open.

PLAY ADAPTATION

Yes, and...how might this EVOLVE?

The trial is not open.

PLAY INVESTIGATION

Curious? Ask or answer a FOLLOW-UP QUESTION ...

The trial is not open.

MOMENTUM CARDS

Other methods of clinical translation=community collaborative research methods; health services/health policy.

NothingAboutUSWithoutUs

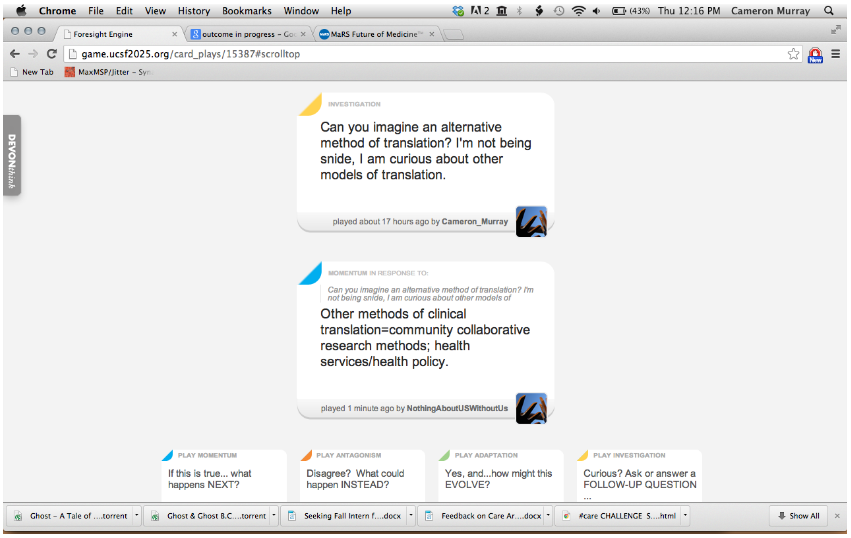
Research priorities, methods and questions should be determined by patients, their caregivers, and clinicians, not Pharma executives.

NothingAboutUSWithoutUs

ANTAGONISM CARDS

ADAPTATION CARDS

INVESTIGATION CARDS



INVESTIGATION

Can you imagine an alternative method of translation? I'm not being snide, I am curious about other models of translation.

played about 17 hours ago by **Cameron_Murray**

MOMENTUM IN RESPONSE TO:

Can you imagine an alternative method of translation? I'm not being snide, I am curious about other models of

Other methods of clinical translation=community collaborative research methods; health services/health policy.

played 1 minute ago by **NothingAboutUSWithoutUs**

PLAY MOMENTUM
If this is true... what happens NEXT?

PLAY ANTAGONISM
Disagree? What could happen INSTEAD?

PLAY ADAPTATION
Yes, and...how might this EVOLVE?

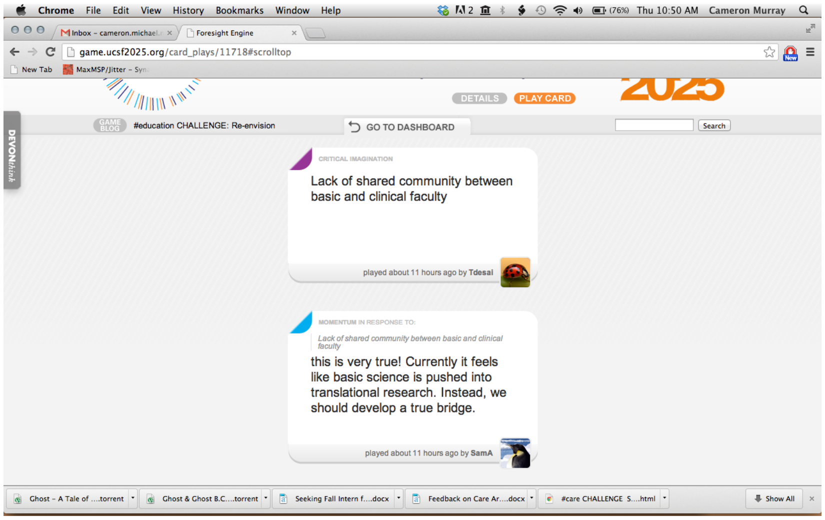
PLAY INVESTIGATION
Curious? Ask or answer a FOLLOW-UP QUESTION ...

Figures 14, 15 and 16: “Other Translations.” Screenshot by author.

Many participants were equally concerned with more dynamic ways of understanding how biomedicine might and should be translated. This was especially true of a participant who called themselves “NothingAboutUSWithoutUs,” a screen name I found out was meant to emphasize their passion for “thinking about this country and this world through the lens of collective action.” They were particularly concerned with whether and how “disenfranchised communities, especially Indigenous communities and people of colour, might be brought into the work we do.” They were one of very few participants I noticed actively “antagonizing” fellow players around the idea that translational medicine does not necessarily mean commercialization. This actually inspired me to engage less directly with NothingAboutUSWithoutUs, choosing instead to join wider threads of conversation; a way to avoid falling into a mode of preaching to the choir.

NothingAboutUSWithoutUs had one main goal, to emphasize the collective action required to build a better future. Their screen name was a statement and a rallying cry, not for radical dismantling of systems and institutions, but for a broader appreciation of the individual and group labour that goes into biomedical research. If translational medicine's success is measured only in monetary (in the form of profits and grants) ROIs, as it was during the CTSI retreat, then a lot of on the ground flesh and blood work gets lost. Like me, NothingAboutUSWithoutUs, was running into a number of problems getting their point across, something I tried on more than one occasion to help with.

NothingAboutUSWithoutUs was not the only one pushing a more inclusive and dynamic understanding of translational medicine. Familiar metaphors of bridges, pipelines and gaps abounded, but a lot of people seemed genuinely concerned with how current discursive frameworks of translational medicine were pitting researchers against one another, rather than bringing them together. Like in Saint John, it was the concept of community that drove much of these debates.



Lack of shared community between basic and clinical faculty

played about 11 hours ago by Tdesai

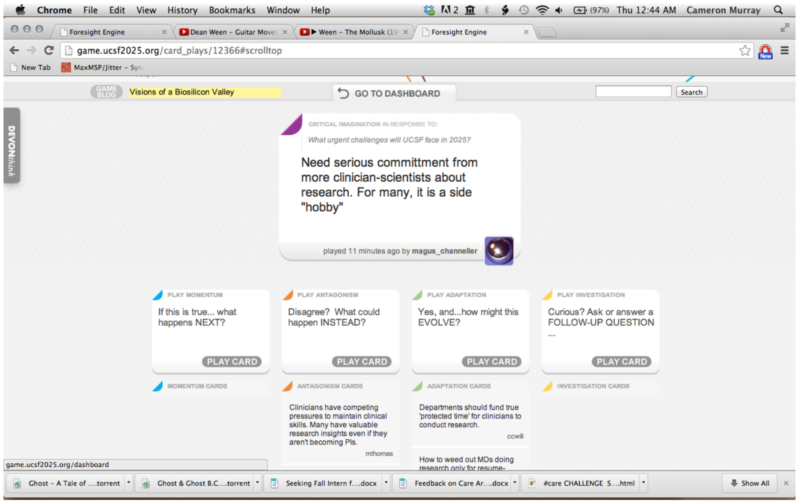
Lack of shared community between basic and clinical faculty

this is very true! Currently it feels like basic science is pushed into translational research. Instead, we should develop a true bridge.

played about 11 hours ago by SamA

Figure 17: "Dreams of a Shared Community." Screenshot by author.

At the same time, many of my earlier concerns, especially around frustrations with the role of clinician-scientists I found in Ottawa and Saint John, were shared by participants. For many, the whole idea of a true clinician-scientist only works if there is a unique depth of passion for both research and clinical practice. Half measures would avail nothing and, in the words of one participant, the key is to “find protected spaces” and times in which clinician-scientists can play the role of researcher.



CRITICAL IMAGINATION IN RESPONSE TO:

What urgent challenges will UCSF face in 2025?

Need serious committment from more clinician-scientists about research. For many, it is a side "hobby"

played 11 minutes ago by **magus_channeller**

If this is true... what happens NEXT?

Disagree? What could happen INSTEAD?

Yes, and...how might this EVOLVE?

Curious? Ask or answer a FOLLOW-UP QUESTION ...

Clinicians have competing pressures to maintain clinical skills. Many have valuable research insights even if they aren't becoming PIs.

mthomas

Departments should fund true 'protected time' for clinicians to conduct research.

ccwill

How to weed out MDs doing research only for resume-

Figure 18: “Serious Play and Clinician-science.” Screenshot by author.

Perhaps more than anything, emphasis was on the idea that truly meaningful biomedical translation could only be practiced by a unique hybrid practitioner. Duncan immediately came to mind. It was refreshing, however, to see that a lot of biomedical researchers, physicians, students and staff seemed compelled by a concern that the social, cultural, political and economic dynamics of biomedicine needed to be taken seriously. I was pleasantly surprised how, well, unsurprising my pushes and pulls from left of center critical STS were to some of these participants. The relief was a palpable reminder of the importance of not making assumptions about the worldviews of interlocutors in ethnographic research.

played 11 minutes ago by **Cameron_Murray**

ADAPTATION

Absolutely needed for real "translational" endeavors. Consider place, time, culture, #social, not just "facts" and "data" #Contextmatters

played 4 minutes ago by **Ruth Malone**

ADAPTATION IN RESPONSE TO:

Absolutely needed for real "translational" endeavors. Consider place, time, culture, #social, not just "facts" and

I'm an anthropologist studying sites of "translational research", and I just finished an article about "context-making". #Happycoincidence

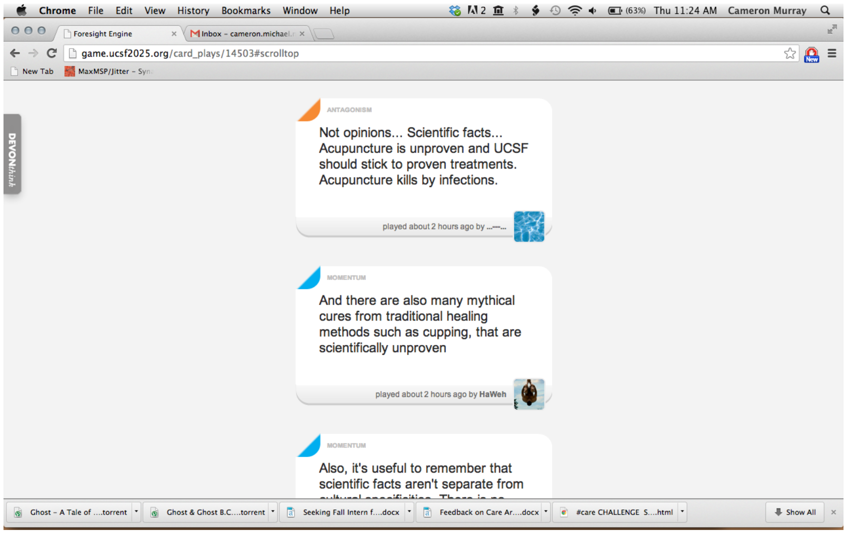
played less than a minute ago by **Cameron_Murray**

Figure 19: "Fellow Context-makers." Screenshot by author

An even further layer of excitement swept over me when I discovered that many were aligned not only with my concerns with translational medicine, scalar dynamics and commercialization, but also with my political preoccupations with contexts and context-making. A particularly fruitful thread of conversation unfolded with a user named Ruth Malone, who at the time was a postdoctoral researcher who had just moved to the UCSF Mission Bay campus from the midwest. Her biggest concern had to do with the ways in which research extracts so much from minds and bodies, in the form of facts, profits, products and practices, with little consideration for the richer contextual threads that go into them. She was passionate about problems facing a biomedical culture so accustomed to reifying research that practitioners fail to see the work of everyone and everything that goes into final translations. For Ruth, the biggest issue was "whether and how patient experiences could truly drive new models of research and clinical practice," without limiting the importance of the expertise of carefully trained researchers and clinicians. Their goal wasn't to dissolve biomedicine into an experience-driven relativism devoid of experts. It was, rather, to recognize that lived experience is a *kind* of expertise, one that clinician-scientists need to find better ways of tapping into.

“Just the Facts”

Beyond these examples where threads of rich engagement were possible, there were other instances where *UCSF 2025’s* design limits made it impossible to know where to even begin deliberating with some participants. In one series of exchanges, a user named HaWah became obsessed with trying to push an “evidence-based” model of translational medicine that devolved immediately into subtly racist attempts at criticizing non-Western health and healing practices. This included a series of conversations with an unnamed user who was adamant that UCSF needed to stop supporting “unproven” treatments, especially acupuncture, because it was a form of murder.



ANTAGONISM

Not opinions... Scientific facts... Acupuncture is unproven and UCSF should stick to proven treatments. Acupuncture kills by infections.

played about 2 hours ago by ...—...

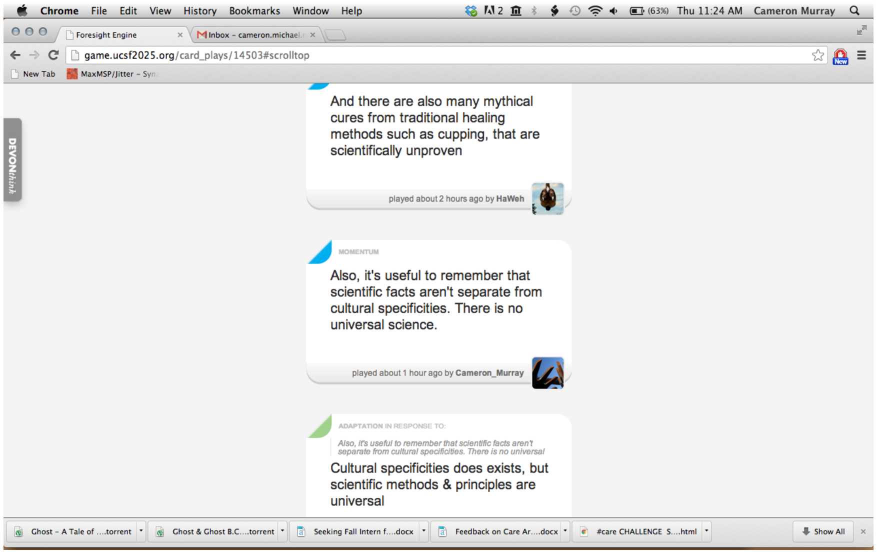
MOMENTUM

And there are also many mythical cures from traditional healing methods such as cupping, that are scientifically unproven

played about 2 hours ago by **HaWeh**

MOMENTUM

Also, it's useful to remember that scientific facts aren't separate from



And there are also many mythical cures from traditional healing methods such as cupping, that are scientifically unproven

played about 2 hours ago by **HaWeh**

MOMENTUM

Also, it's useful to remember that scientific facts aren't separate from cultural specificities. There is no universal science.

played about 1 hour ago by **Cameron_Murray**

ADAPTATION IN RESPONSE TO:

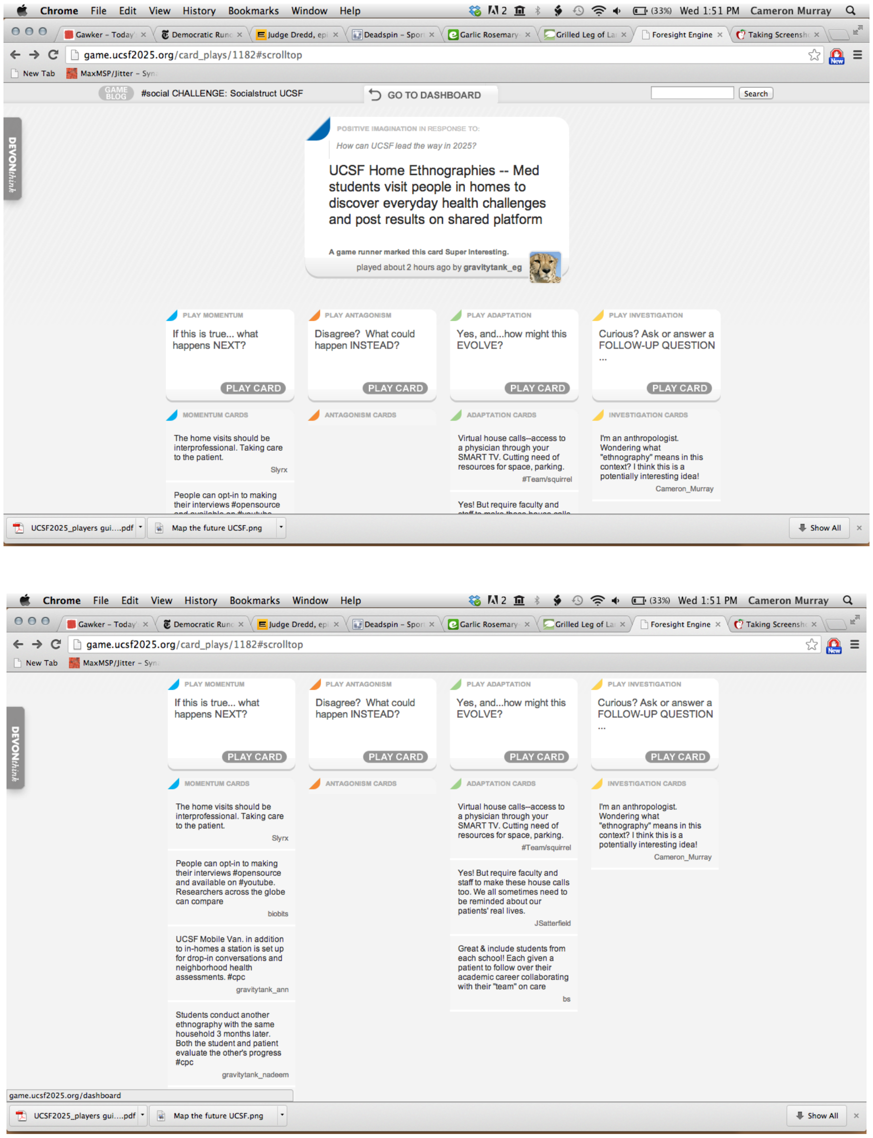
Also, it's useful to remember that scientific facts aren't separate from cultural specificities. There is no universal

Cultural specificities does exists, but scientific methods & principles are universal

Figures 20 and 21: "STS 101." Screenshot by author.

My attempts to engage in these threads felt incredibly lacking, reminiscent of something we often experience teaching STS to undergraduates. The layers of determinism, narratives of unfettered progress and assumed universal validity and objectivity of science are not easily dismissed in short Twitter-length bursts. At one point, I simply wrote, "…it's useful to remember that scientific facts aren't separate from cultural specificities. There is no universal science." HaWah responded within seconds, in terms so terse and dismissive that I realized I was going to get nowhere trying to push deeper. "Cultural specificities (*sic*)," he offered, "does exist, but scientific methods & principles are universal."

Further frustrations with *UCSF 2025*'s design emerged when topics turned to how social studies of science and medicine might help build new models of translational medicine. As conversations tapped into historical, sociological and anthropological practice, it became difficult to get a sense of the seriousness with which people were using terms like "ethnography." One proposal in particular, from a physician named "gravitytank_eg", focused on the need for UCSF to build a "home ethnographies" platform for medical students. The idea was for students to collect and share contextual experiences of people living with chronic illness, to better prepare doctors-in-training for what textbooks can never capture. The initial proposal card was flagged by game runners as “Super Interesting,” a sign that they were hoping it would get extra traction as much via their official Twitter feed as within the game itself.



POSITIVE IMAGINATION IN RESPONSE TO:

How can UCSF lead the way in 2025?

UCSF Home Ethnographies -- Med students visit people in homes to discover everyday health challenges and post results on shared platform

A game runner marked this card Super Interesting.

played about 2 hours ago by **gravitytank_eg**

If this is true... what happens NEXT?

Disagree? What could happen INSTEAD?

Yes, and...how might this EVOLVE?

Curious? Ask or answer a FOLLOW-UP QUESTION ...

The home visits should be interprofessional. Taking care to the patient.
Slyrx

People can opt-in to making their interviews #opensource and available on #youtube. Researchers across the globe can compare
biobits

UCSF Mobile Van. in addition to in-homes a station is set up for drop-in conversations and neighborhood health assessments. #cpc
gravitytank_ann

Students conduct another ethnography with the same household 3 months later. Both the student and patient evaluate the other's progress #cpc
gravitytank_nadeem

Virtual house calls--access to a physician through your SMART TV. Cutting need of resources for space, parking.
#Team/squirrel

Yes! But require faculty and staff to make these house calls too. We all sometimes need to be reminded about our patients' real lives.
JSatterfield

Great & include students from each school! Each given a patient to follow over their academic career collaborating with their "team" on care
bs

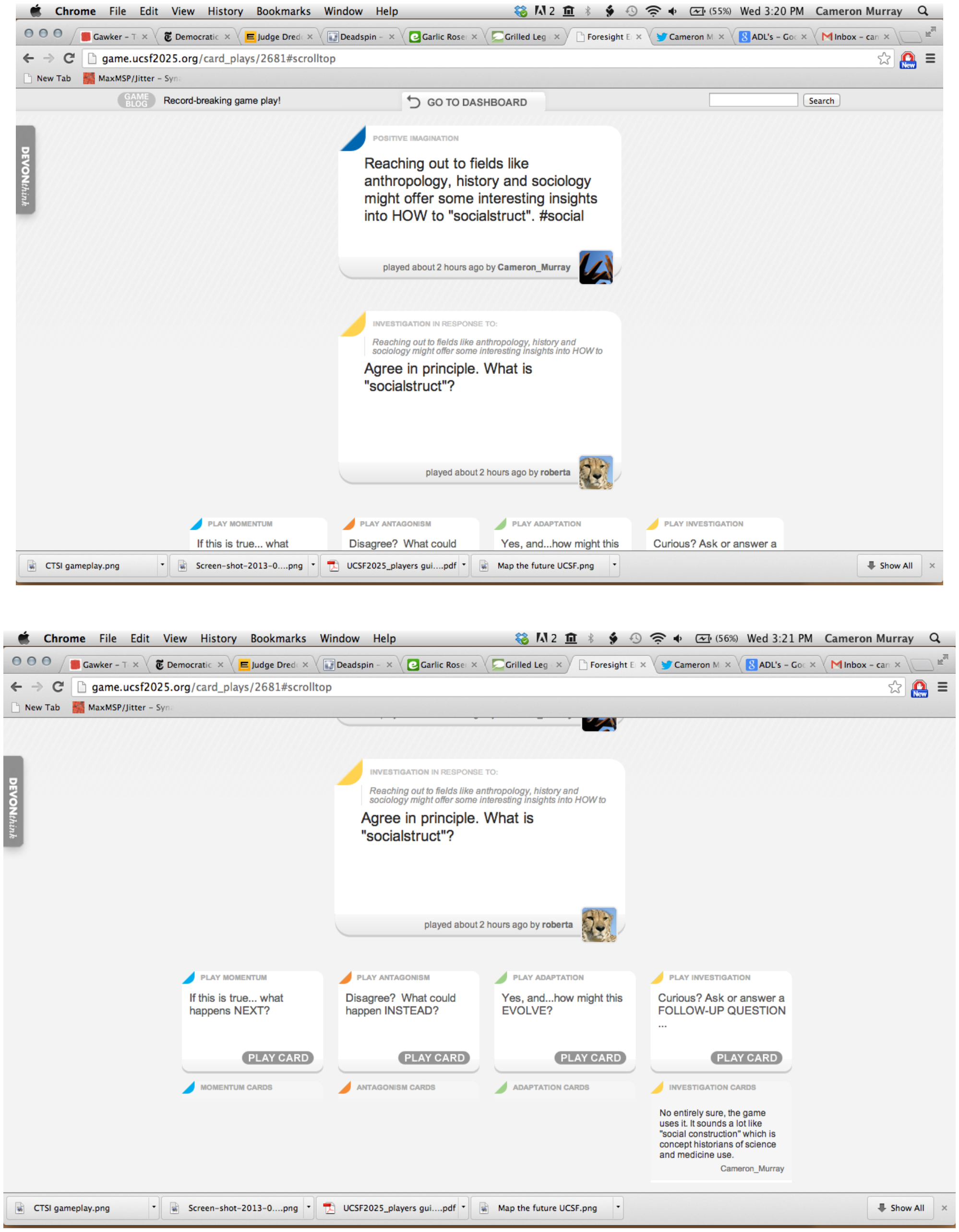
I'm an anthropologist. Wondering what "ethnography" means in this context? I think this is a potentially interesting idea!
Cameron_Murray

Figures 22 & 23: “What is Ethnography?” Screenshot by author.

I loved the idea initially, but was thrown by how immediately the conversation jumped to how these home ethnographies would provide raw material for students, faculty, doctors, nurses, and other practitioners who would “benefit from the potential this has for giving us longitudinal data over time.” As a model for translational medicine, this seemed like a fruitful angle, but I was shocked how quickly patients turned into resources rather than active collaborators in the translation process. Again, I was held back by the limited frameworks in which I could work. I wanted, more than anything, to simplify the discussion around what “ethnography” meant and how it would be practiced in this particular suggestion.

Design Limits

As noted, the expansive, flexible and dynamic potential of *UCSF 2025*’s infrastructure was tempered by the inability to post more than a 140 character “micro-contribution.” This generated a number of problems and many of my cards became, what Tim Ingold (2007) might call, “dotted lines” rather than rich threads of provocative engagement. This was especially true when trying to use game-centric catchphrases to set up suggestions for bringing STS and translational medicine together. The game had dozens of suggested terms, many of them pulled from trendy playbooks from experience design companies. The problem was that every time I would mobilize one of these terms, I would be caught off guard by how few participants seemed to be following what I was saying. I had assumed these were more common than they ended up being, which made for some hilariously stilted conversations.



Reaching out to fields like anthropology, history and sociology might offer some interesting insights into HOW to "socialstruct". #social

played about 2 hours ago by **Cameron_Murray**

Reaching out to fields like anthropology, history and sociology might offer some interesting insights into HOW to

Agree in principle. What is "socialstruct"?

played about 2 hours ago by **roberta**

If this is true... what happens NEXT?

Disagree? What could happen INSTEAD?

Yes, and...how might this EVOLVE?

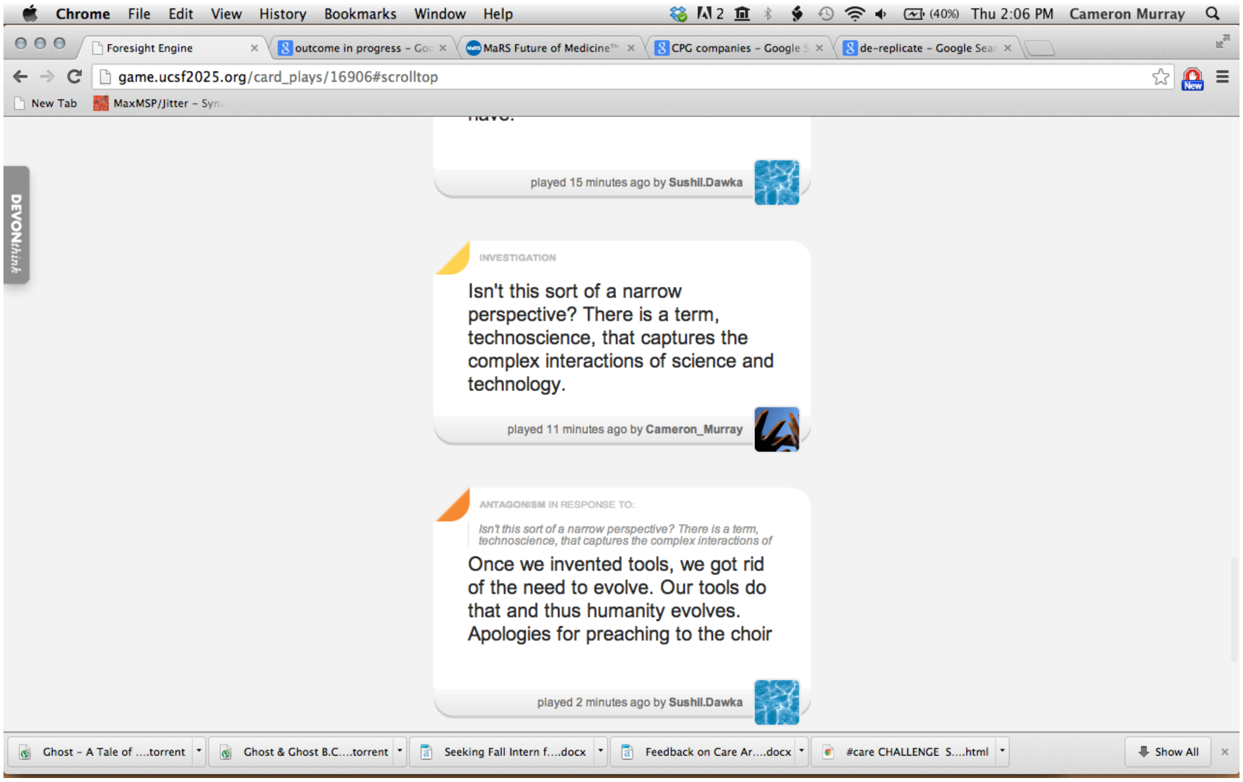
Curious? Ask or answer a FOLLOW-UP QUESTION ...

No entirely sure, the game uses it. It sounds a lot like "social construction" which is concept historians of science and medicine use.

Cameron_Murray

Figures 24 and 25: “What is ‘Socialstruct’?” Screenshot by author.

Still, the greatest limit to my ability to engage with fellow players was the overall structure of the game as a promotional tool rather than a truly deliberative platform for imagining possible futures. Some concepts, no matter how common sense to someone who has already “drank the Kool-Aid”, as one player put it, simply require a lot more than 140 characters, and a much more welcoming environment to allow two or more people from vastly disparate domains of expertise to start forging a common path with one another. Which brings me back to Sushil:



played 15 minutes ago by **Sushil.Dawka**

INVESTIGATION

Isn't this sort of a narrow perspective? There is a term, technoscience, that captures the complex interactions of science and technology.

played 11 minutes ago by **Cameron_Murray**

ANTAGONISM IN RESPONSE TO:

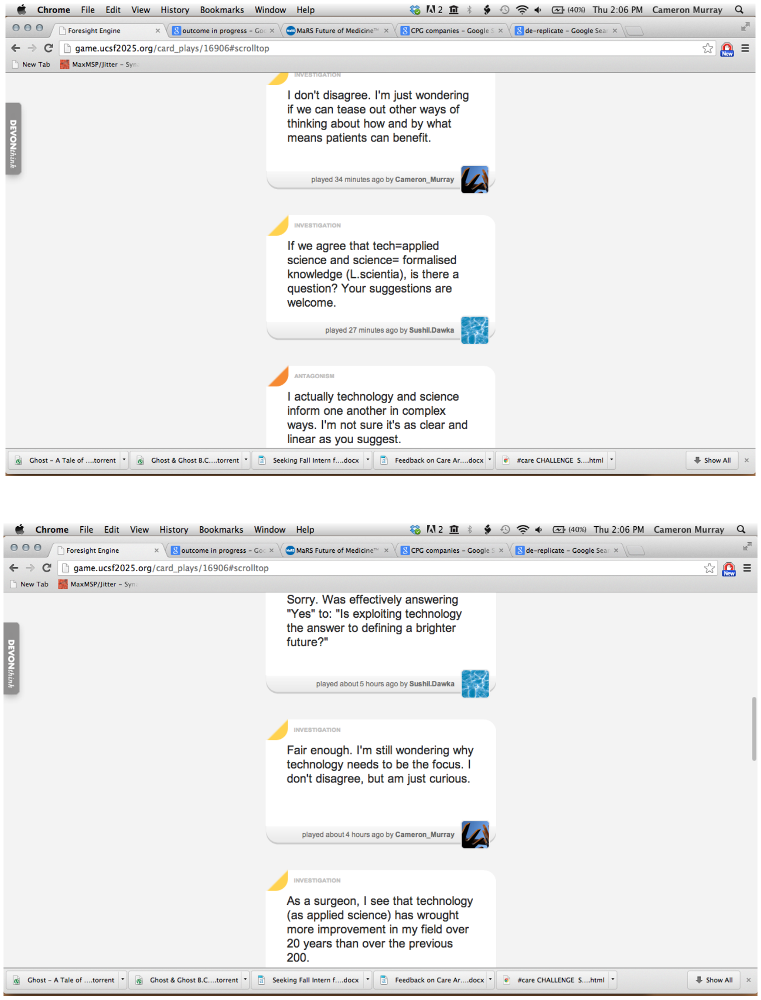
Isn't this sort of a narrow perspective? There is a term, technoscience, that captures the complex interactions of

Once we invented tools, we got rid of the need to evolve. Our tools do that and thus humanity evolves. Apologies for preaching to the choir

played 2 minutes ago by **Sushil.Dawka**

Figure 26: "Introducing…TECHNOSCIENCE!" Screenshot by author.

Having taught courses in STS, anthropology and science policy to high school and undergraduate students, I started to treat interactions within *UCSF 2025* as teachable moments. I do not mean this in a patronizing way. I was, rather, motivated by a sense of wanting to inspire people in this game with phrases and sensitivities that make teaching key ideas in the social studies of science so exhilarating. At one point, with Sushil, I realized that he was making statements that sounded like the same red flags I would warn my undergraduate students about. He was coming across as a technological determinist, a techno-utopian, one overemphasizing grand narratives of technological and scientific progress. I might not have had the bandwidth or character limits required to get into all that, but I could start to introduce a core STS concept, *technoscience*, one relatively easy to define, and see where that might get us.



game.ucsf2025.org/card_plays/16906#scrolltop

INVESTIGATION

I don't disagree. I'm just wondering if we can tease out other ways of thinking about how and by what means patients can benefit.

played 34 minutes ago by Cameron_Murray

INVESTIGATION

If we agree that tech=applied science and science= formalised knowledge (L.scientia), is there a question? Your suggestions are welcome.

played 27 minutes ago by Sushil.Dawka

ANTAGONISM

I actually technology and science inform one another in complex ways. I'm not sure it's as clear and linear as you suggest.

game.ucsf2025.org/card_plays/16906#scrolltop

Sorry. Was effectively answering "Yes" to: "Is exploiting technology the answer to defining a brighter future?"

played about 5 hours ago by Sushil.Dawka

INVESTIGATION

Fair enough. I'm still wondering why technology needs to be the focus. I don't disagree, but am just curious.

played about 4 hours ago by Cameron_Murray

INVESTIGATION

As a surgeon, I see that technology (as applied science) has wrought more improvement in my field over 20 years than over the previous 200.

Figures 27 and 28: "Grappling with Technological Determinism." Screenshot by author.

At every moment in our conversations, Sushil and I were speaking different languages, again reminiscent of my time with the director of ethics featured in Part 1. The problem was translational, but overcoming it had more to do with the designed environment of *UCSF 2025*. The actual game play limits made it impossible for us to exist in an environment in which we could learn to work together. We were just spitballing in and around two fundamentally different ways of seeing and knowing the world. This was the ultimate limitation to the game's capacity to allow STS sensitivities to meaningfully shape UCSF's future forecasts. In the end, Sushil and I fell into an all too familiar situation. I had so taken for granted my perspective that I just kept coming at Sushil with one liners that could only ever land had he too read and engaged with the same material that shaped the very reasons why I came here in the first place. Our final back and forth, which happened just a half hour before *UCSF 2025* was set to close, speaks for itself:

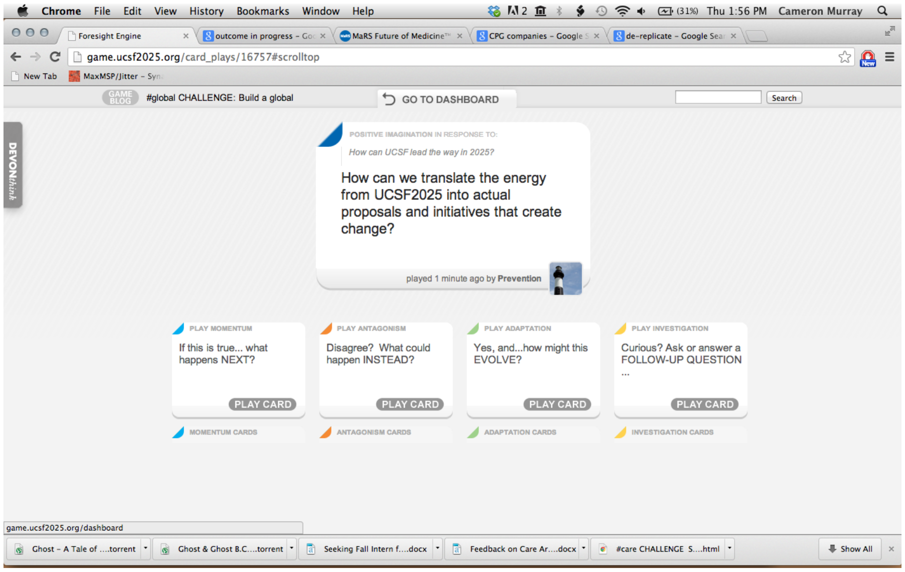
> C: Isn't it worth making difference and uncertainty productive? Why is a singular culture and ethics important?
>
> S: Diversity has not proven to engender mutual respect over history. Let's give homogenization a chance. Just saying.
>
> C: Okay, but how would we go about "homogenizing", and who determines what to keep and what to get rid of in terms of culture and ethics?
>
> S: It has to emerge to be acceptable to all. Something like the national language and culture that evolves in multilingual nation-states.
>
> C: I think we need to be more realistic, and embrace rather than gloss over the multiple cultures and ethical frameworks that guide research.
>
> S: Well said. Anything that promotes research and doesn't harm humanity.

We have to accept that the physical and digital infrastructures in which we work, observe, encounter and engage have been pre-codified, or designed, by various interests, whether expert, corporate, political, etc. Of course there's room for alternative accounts and engagements, but the possibilities are not endless. Design, especially in the era of late capitalism, might use the rhetoric of openness and flexibility, but it is just as much about limitation and finitude as it is expansion. This is an important thing to keep in mind when we engage in serious play in order to forecast the future practices, institutions and infrastructures of biomedical research.

Serious Play and the Challenge of Next Steps

In the end, I placed 34th out of 2583 players. Players in the top 30 received prizes, in the form of gift cards, and ideas deemed novel by game moderators were posted on the game's official website and Twitter accounts. Participants in the game were not simply encouraged to post whatever they wanted. The experience of the game was influenced in part by the introductory video, the initial critical and positive imagination cards posted by game moderators, as well as periodic interventions by game moderators posing questions meant to change the general category of discussion and inspire new chains of debate and collaboration. We might categorize *UCSF 2025* as an example of "serious play." According to Johan Huizinga:

> all play moves and has its being in a playground marked off beforehand materially or ideally, deliberately or as a matter of course. Just as there is no formal difference between play and ritual, so the 'consecrated spot' cannot be formally distinguished from the play-ground. The arena, the card-table, the magic circle, the temple, the stage, the screen, the tennis court, the court of justice, etc., are all in form and function play-grounds – forbidden spots, isolated, hedged round, hallowed, within which special rules obtain. All are temporary worlds within the ordinary world. Dedicated to the performance of an act apart (1938, 10).



POSITIVE IMAGINATION IN RESPONSE TO:

How can UCSF lead the way in 2025?

How can we translate the energy from UCSF2025 into actual proposals and initiatives that create change?

played 1 minute ago by **Prevention**

PLAY MOMENTUM
If this is true... what happens NEXT?
PLAY CARD

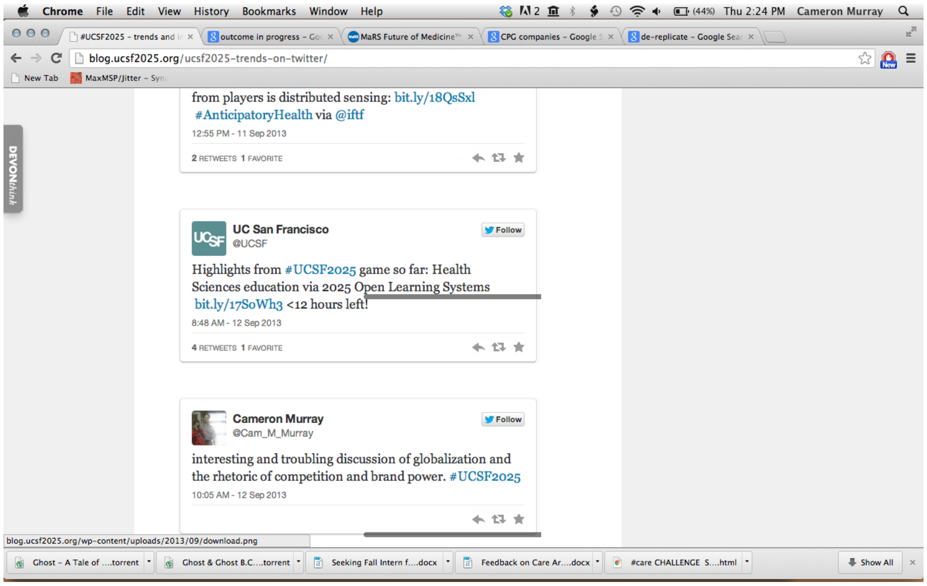
PLAY ANTAGONISM
Disagree? What could happen INSTEAD?
PLAY CARD

PLAY ADAPTATION
Yes, and...how might this EVOLVE?
PLAY CARD

PLAY INVESTIGATION
Curious? Ask or answer a FOLLOW-UP QUESTION ...
PLAY CARD

Figure 29: "Energy Translation." Screenshot by author.

People playing *UCSF 2025* were clearly aware that the game was not a concrete mechanism for radical change. It was not a holy path to enlightenment and precognition. It was, in the words of one participant, at most an "energy" that might be productively "translated" into action. That was not, however, the goal of *UCSF 2025* for the IFTF developers or the administrators who helped put it together. The game was, first and foremost, a 36 hour promotional vehicle. And I fully bought in, getting excited not just when my points increased, but when I received alerts about the fact that my own cards were being used by UCSF's official Twitter account to "tell the world" about what they called our "epic game play."



from players is distributed sensing: bit.ly/18QsSxl #AnticipatoryHealth via @iftf
12:55 PM - 11 Sep 2013
2 RETWEETS 1 FAVORITE

UC San Francisco
@UCSF
Highlights from #UCSF2025 game so far: Health Sciences education via 2025 Open Learning Systems bit.ly/17SoWh3 <12 hours left!
8:48 AM - 12 Sep 2013
4 RETWEETS 1 FAVORITE

Cameron Murray
@Cam_M_Murray
interesting and troubling discussion of globalization and the rhetoric of competition and brand power. #UCSF2025
10:05 AM - 12 Sep 2013

Figure 30: "Did you hear the one about the snake eating its own tail?" Screenshot by author.

Games are rule bound, generating finite spaces that provide limits perceived to be necessary for productive encounters, whether collaborative or competitive. Games are designed. Games generate their own discursive economies and embodied practices, which are motivated, to some extent, by the goals of those who seek the game's design in the first place. Choosing Twitter over other social networking platforms as the model for

UCSF 2025 and other IFTF games is significant. As linguist Ruth Page has pointed out, each social networking platform generates its own linguistic marketplace. In the case of Twitter, that marketplace is driven by the currency of short 140 character updates and the circulation of hashtags. As she puts it:

> Twitter is a linguistic marketplace (Bourdieu, 1977) in which the processes of self-branding and micro-celebrity (Marwick, 2010) depend on visibility as a means of increasing social and economic gain. Hashtags are a potent resource within this system for promoting the visibility of a Twitter update (and, by implication, the update’s author) (2012, 181).

Her broader point is that participation in social media is neither neutral nor evenly distributed. Page argues that participation on Twitter is constrained by market forces and hierarchies of power that “interweave offline and online contexts”, particularly in the site's ability to enable “self-promotion strategies that result in social or economic gain” (2012: 182). *UCSF 2025* might be said to suffer from the same issues, though on a smaller and slightly more focused scale.

CONCLUSION TO PART 2:
the politics of design

Following the work of Peter Sloterdijk (2012), I argue that design is neither static nor politically neutral, but rather a lively practice that can simultaneously expand and constrain possibilities for intimate encounters and collaborations. Bruno Latour has championed Sloterdijk as *the* quintessential philosopher of design. Like Latour and other STS researchers, Sloterdijk wants to move beyond perceived dichotomies between fact and fiction, the real and the constructed. Sloterdijk's most challenging work, the three-volume, 2500 page opus, *Spheres,* is an attempt to trace the ways in which even a walk outside involves the mutual and unavoidable design of "body friendly environments." Referring to all shared spaces, what he calls "spheres", as "air-conditioning" units, Sloterdijk argues that to be human is always to exist within designed environments, spaces and experiences that are structured to support and extend our vital capacities.

I am interested in how the designed spaces and experiences of translational research simultaneously expand and limit possibilities for intimate encounters and collaborations. I am interested in how designed spaces and experiences can generate what Bruno Latour, Isabelle Stengers and Vinciane Despret have called "articulated propositions." Articulated propositions are not textual or verbal "statements," but rather embodied, material phenomena. Propositions for Latour, Stengers and Despret are occasions for entities to enter into contact with one another. Articulations are relations between propositions that generate differences, effects, and alterations, some of which are nearly impossible to plan for in advance or trace afterwards. The concept is meant to help one move beyond questions like "is such and such an entity, or collective, real or constructed?” “Bodies learning to be affected,” Latour writes, “by hitherto unregistrable differences through the mediation of an artificially made set up” (Latour 2004, 4). With articulated propositions one learns to be affected, “learns to embrace a multiplicity of differences, and learns to accept that reality and artificiality are synonyms, not antonyms” (Latour 2004, 213). This, for me, is a productive way to reflect on the simultaneously hollow and substantive ways in which both translation and design are deployed in certain settings of translational medicine, like DMNB and UCSF. Desires for concrete improvements in healthcare research, practice and outcomes rub uneasily against capital-driven plans for profit and brand recognition. These tensions are baked into the design of spaces, strategies and experiences of translational medicine that I’ve encountered in my research so far. This is as much true for the DMNB and Brunt Research Lab in Saint John as it is for CTSI’s NIH funding retreat and *UCSF 2025*.

Care-filled Design

Following recent work in feminist science studies (de la Bellacasa 2017), I think that caring implies a process of seeking out and accepting inherently unpredictable relationships between humans and nonhumans, matter and ideas, while also developing new and flexible ways to engage, intervene and move forward. I seek to be affected by and to affect others, but not always in ways that are easily traced. To design, in my view, is not to “originate” nor should it be understood as a purely aesthetic or politically neutral set of practices. To design is always to enter into a multi-directional flow of uncertain entities, collectives, interests, imaginaries and resistances.

Translational medicine provides a unique lens through which to study the anxious futurity of design thinking. The threads of hollow and substantive discourses and designs that I've explored so far compel me to question the extent to which care is or ever can be more embedded at DMNB and UCSF. Carrie Friese has argued that the potential for translational medicine to produce truly novel approaches to biomedical research and innovation is intimately tied to the extent to which care is part of the process. A problem, Friese suggests, arises when we consider the vast number of non-research stakeholders destined to be embedded in the translational medicine enterprise:

> Gaps and rifts in the translational process may create problems vis-à-vis extrascientific actors enrolled in the scientific project, including funders, clinicians, patients, and—I would add—the people and organizations concerned about the systematic use of animals in bioscientific and biomedical research. However, these gaps and rifts are nonetheless a source of curiosity in science precisely because new kinds of questions become possible both to ask and to address. As such, there is a dilemma regarding the ways futurity operates in bioscience and biomedicine in that promises are made to generate financial and other kinds of support for research that, if it is to remain scientifically interesting, cannot seamlessly resolve itself into a therapeutic (2013).

For the last decade, care has become increasingly embraced and scrutinized, particularly by feminist, queer and post-colonial STS scholars. Maria Puig de la Bellacasa (2011) provided a watershed publication on this front, extending Latour's "matters of concern" to account for and embed feminist engagements with theories and practices of care. Matters of care, as she put it, remind us that biomedical research and practice are complex entanglements of material entities, affective connections, technological platforms, ethical challenges and political contexts. This has profound implications for how we understand the role of design in overcoming past and present, and forecasting future challenges through biomedical translation. As Friese puts it:

> Care practices are thus potentializing. Indeed, care is central to the everyday idea of potential itself. In its most common valence, potential denotes the idea that someone or something must be nurtured so that a kernel of ability or talent is actualized in practice. In this sense, both potential and care defy notions of

> generality, universality, and determinism. Both are temporally and spatially located, process-based ideas that connect past, present, and future through the dynamics of interaction (2013).

Following the work of Mol (2002), Haraway (1992) and Puig de la Bellacasa (2011), Friese's conflation of care and potential can inspire new ways of critiquing the emerging design mentality in translational medicine. As with the valley of death metaphor, the perceived hollowness of events like CTSI's NIH funding retreat doesn't take away from the life and death stakes of translational medicine more broadly. As a result, if we add design as a critical dimension of the relationship between care and potential, we can remind ourselves of the seriousness of even the most frivolous events, episodes and experiences. In Hassenzahl's (2013) words, meaning-making is going to happen no matter what, even if meaning itself is inherently fleeting and unstable. As Friese puts it:

> We may say the same of potentiality in that it is a process that does not necessarily end once certain goals are achieved but is instead continually reshaped in reference to outcomes that are actualized in time and enfolded in interaction. Both care and potentiality highlight the contingency and fragility of life, which must be acted on as politics and choice rather than repressed through deterministic metaphors (2013).

Feminist and queer critiques of contemporary design thinking have been trying for years to add layers of ethics to the "contingency and fragility" of design in healthcare and computer science. Van der Velden and Mörtberg (2012) have argued that, whether designing devices or experiences, design is an ethical practice of unstable enactments. Specifically referring to gender dynamics at play in technology design, they argue that:

> …each iteration in the design process is an intra-active cut, in which design and gender comes into being. What emerges out of this process is dependent on what is included and excluded in the ongoing practices. This makes designers ethically responsible for these intra-active cuts, as each cut affects our responsibility to the Other" (2012, 679).

With ethics and enactments in mind, Van der Velden and Mörtberg have become proponents of new models of participatory and deliberative design. Whether referring to experiences or technologies, participatory design refers to "a value-centered design approach because of its commitment to the democratic and collective shaping of a better future" (2015, 41). They argue that participatory democracy is important because of its guiding principles: 1. equalizing power relations; 2. democratic practices; 3. situation-based action; 4. mutual learning, tools and techniques; and 5. alternative visions about technology (2015, 42). These principles might be idealistic and impossible to fully achieve, but they speak to a more care-filled approach to understanding the goals of designing devices, environments and experiences.

These principles, on paper, reflect the messy design needs and challenges facing translational medicine's proponents. My participation in *UCSF 2025*, a collaborative game meant to help a diverse range of stakeholders forecast a better biomedical future, represents a specific and disappointing encounter with care in design. Care, ethics, participation, deliberation and democratization of decision-making were all championed as the focus of this event. I argue that it was the design of *UCSF 2025*, as both an experience and a digital platform, that limited the deliberative, caring and democratic potential of the game.

Beyond Shipbuilding

As noted in Part 1, I do not doubt that biomedical researchers, doctors and university administrators want to improve the lives of patients and loved ones through translational medicine. At the same time, however, the impossibility of separating real from artificial, fact from fiction, physical from virtual/digital, makes it important to trace the deceitful (Flusser 1999) dimensions of discourses and designs in places like Saint John and San Francisco. These are two sites in the midst of decades-long revitalization projects. Building robust, globally respected research hubs is tied to scalar ambitions that jump rapidly from biological research to institutional and regional economic success. The spaces and experiences shaping the contours of these emerging hubs are necessarily framed by multiple, sometimes conflicting, design strategies and plans for the future.

As noted, both Mission Bay and Saint John represent former shipbuilding hubs turned biomedical trading zones (Galison 1998, 2010). They operate at different sizes and with different levels of global influence, but they share narratives of economic collapse and recovery that are worth elaborating on. At the same time, Saint John represents a site hoping one day to succeed in ways comparable to UCSF Mission Bay. As a result, both sites represent unique examples of research hubs in the making, shaped by a desire to overcome decades of economic collapses and challenges.

Biomedical research and innovation are meant to return Saint John and Mission Bay to their status as economic powerhouses not seen since their shipbuilding days. San Francisco's shipbuilding heyday lasted from the middle of the 19th century until the end of World War II (Dearman 2004). As noted earlier, Mission Bay was a key part of this shipbuilding boom, and the industry itself was long tied to the "dreams and schemes" of those speculating about the area's growth (Olmsted 2007). Following World War II, the area went into a long "period of neglect" (Olmsted 2007) that it has only recently begun to come out of, thanks to the development of UCSF's Mission Bay campus. An article in *Found SF* by Alexandra Berzon summarizes the relationship between Mission Bay's shipbuilding past and its biotechnological future:

> In a city that made a mall out of a chocolate factory and lines its historic fishery with wax museums, Pier 70 is perhaps the best place to see the old San Francisco -- the blue-collar port town left to die, but still breathing.
>
> Between the high-tech, half-built glass structures of Mission Bay and the toxic, closed-down military base at Hunters Point, the bay shore makes a slow curve. Here, at the base of Potrero Hill, the new economy of biotechnology and *baristas* almost touches what remains of the world of giant industrial ships and machinists (2005, para. 2).

Berzon and Olmsted, both local historians of Mission Bay, make explicit connections between this shipbuilding past and biotechnological future in terms of reviving a dying body of land and commerce. It is this explicit connection between two unique periods of economic aspiration that informs my concern with the confusing ways in which design has been deployed in the context of translational medicine in Saint John and San Francisco.

In August 2013, one month after my trip to Mission Bay for the CTSI funding retreat, and one month prior to my participation in *UCSF 2025*, I was walking through New Brunswick Museum in Saint John. The museum has rooms filled with models and artifacts reflecting a uniformly positive take on the city's fur and shipbuilding industries.[43] These celebratory spins on the city's past do not reflect the social and economic realities of its present. The New Brunswick Museum, located in Saint John's Market Square, is built on the exact spot where those ships were manufactured, and serves as the centrepiece of a 1970s waterfront revitalization project that refuses to age gracefully. The revitalization was one of many projects designed to change the fate of a city that, over the course of the twentieth century, has become one of the least

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[43] At the time of my initial visit the museum was also home to a shockingly ill-informed special exhibit celebrating collaborations between Indigenous and European fighters during the War of 1812.

"desirable" places in Canada, lacking the economic, cultural and political vitality to maintain its population.[44]

Twenty-six years after the arrival of Champlain, famed fur trader Charles de Saint-Étienne de La Tour would set up a fort at the entrance of the *Fleuve Saint-Jean*, generating what M.A. Macdonald (1983) called a "river highway" down which "fleets of canoes" would bring with them "the richest fur harvest in all Acadia." For more than a hundred years the mouth of the Saint John expelled riches in fur that established the area as a crucial profit pipeline for colonists. The economic power and potential of the region was further realized with the city's fledgling but rapidly evolving shipbuilding industry, an industry that further displaced the Wolastoqiyik people from their land, language, bodies, and culture. Dominant histories of shipbuilding represent a further displacement, the consequence of which is the almost complete removal of Wolastoqiyik and neighbouring nations' contributions to the manufacturing and operation of imperial vessels of war and commerce.

Representing the two key periods of Saint John's Euro-imperial dominance in economic trade and uneven cultural translation, the fur and shipbuilding industries are narrated as success stories, reminders of a past to which the builders of the new biomedical campus hope to return.[45] However, "success" in trade and translation is

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[44] The real shipbuilding boom would come with the arrival of the British Loyalists, the culturally diverse hodgepodge of British supporters during the American Revolution, on the Maritime coast. The Loyalists provided new scales and scopes of the region's contributions to the European empire. Spurred by the loss of a number of American colonies during a series of key battles, the Loyalists had arrived in Saint John in 1783 to take advantage of "the vast stands of timber that covered New Brunswick and Quebec" (Thomas & Barton 1939: 43). Initially, Royal Navy ships would arrive in Saint John to obtain vast cargoes of spars--sturdy poles to hold up a ship's mast--and deals--a cheaper wood for ship maintenance. However, as Lowell and Barton put it, "ships of war could not be spared to transport the ever-increasing quantity of timber that came floating down the rivers. It was then that ship-building began in earnest in Saint John; great cargo carriers to freight a forest across the sea" (1939: 43-4).[#] At its peak Saint John accounted for a majority of Canada's shipbuilding effort and offered a critical point of import and export not only with Great Britain but with the West Indies as well. All of this led Alexander Monro, the British anatomist, physician and medical educator to suggest that:

> ...looking at the advantages it possesses from its position at the entrance of a noble river, second to none in British North America except the St. Lawrence, and possessing the great advantage over that river of being free from ice during the whole year, the conclusion forces itself on our minds that, before many years roll around its commerce will be inferior to that of few places on the North American Continent (1855: 128).

[45] A mere twenty years after Monro's confident articulation of Saint John's economic potential, wooden square-rigged sailing vessels were all but obsolete. Wooden ships were giving way to more efficient steam-powered, small-crewed steel ships that continue to define the industry. By the 1890s:

relative, always the result of violent imbalances of power, people, and profits. In the case of La Tour, battles with the English and so-called "uncooperative" Indigenous people over who should define and control the dominant industries and narratives of the region left a brutal, bloody wake. In this wake, the shipbuilding industry filled the coffers of British Loyalist elites, while further promoting and actively steering the intolerant cultural myopia of the seafaring Empire. It is within this complex and fleshy political history of trade and translation that research hubs in both Saint John and San Francisco have emerged.

Rather than "river highways" down which furs, forests, and empires traverse, "success" in Saint John and Mission Bay depends on literal and figurative pipelines of oil, information, living bodies and commerce that simultaneously generate and are designed to resolve serious health and economic woes facing vulnerable and underserved populations. Steering these ships of biomedical innovation is another culturally diverse hodge-podge, this one made up of locally/regionally sourced students and business leaders alongside national and international graduate students, professors, researchers, and administrators.

USCF Mission Bay and DMNB are explicitly described as critical to saving "injured" and "dying" economies. In Saint John, for instance, DMNB and the new emphasis on biomedical research is part of a much longer story of the slow development of a post-secondary education culture in the city. In Peter McCahan's *The "Quiet Campus": A History of the University of New Brunswick in Saint John, 1959-1969,* the

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> …many of the builders and owners were old men, and few of the younger men were willing to continue the business. While the wooden sailing ship could be built with little overhead, a great deal of capital was needed to establish and outfit yard for building steel vessels. Although steel vessels could carry large cargoes, they were more expensive to buy and required more capital to operate. The great profits of the earlier years were no longer to be made and most businesses preferred to put their money into more lucrative ventures" (Armour and Lackey 1975: 99).

Steam and steel had, along with the evolving socio-political dominance of Ontario and Quebec, turned Saint John into a city of stagnation "trying to renew memories of past days when this was the fourth ranking shipbuilding port in the world" (Schuyler 9).

city had long sought a universal plan for changing its fate, in areas as diverse as literature and theatre, as well as heritage celebrations of its past glories as a hub of economic dominance and innovation in the eighteenth and nineteenth centuries. As McCahan put it:

> Much work remained to be done to strengthen theatre and literary presentations, as well as historical and heritage celebrations for the city's residents and their accomplishments. One of the most significant gaps existed in the education sphere. Saint John by the 1950s still lacked its own post-secondary educational institutions—whether they be two-year junior academic colleges or fully independent universities. This omission was for many an especially dramatic symbol that Saint John was indeed an 'injured city'. Through the 1960s an increasing impetus grew to address this gap" (1997, 4).

Finally establishing a post-secondary institution was long seen as key to shifting how and by what means the city of Saint John's could (re-)establish even a fraction of its former social and economic dominance. Finally, in the 1950s and 1960s, a small two-year junior college was built, designed to "funnel" students into the University of New Brunswick's main campus in Fredericton. The modest campus, located mere feet from the intersection of the rivers St. John and Kinnebacasis, has grown into a small but reputable four-year school for a number of programs, including history and environmental sciences. In the last decade, however, it has set its sights on a much bolder path towards healing the wounds of this "injured city."

DMNB and UCSF Mission Bay represent unique design challenges because they can't be separated from the global commercial aspirations underlying their development. This has a serious impact on how translational medicine is taught and practiced, and highlights why so many of my deliberations within *UCSF 2025* felt so hollow and stunted. My frustration became such that I sought new ways of engaging translational medicine.

Rather than working within sites that were already off to the races with their messy combination of multi-scalar commercial and healthcare ambitions, I wondered how I might take my own preoccupations with translation and deliberation in order to *teach* translational medicine. I got that chance in the summer and fall of 2014 and again in the summer of 2015.

part 3

TEACHING TRANSLATION: SCIENCE LITERACY AND DELIBERATIVE PEDAGOGY

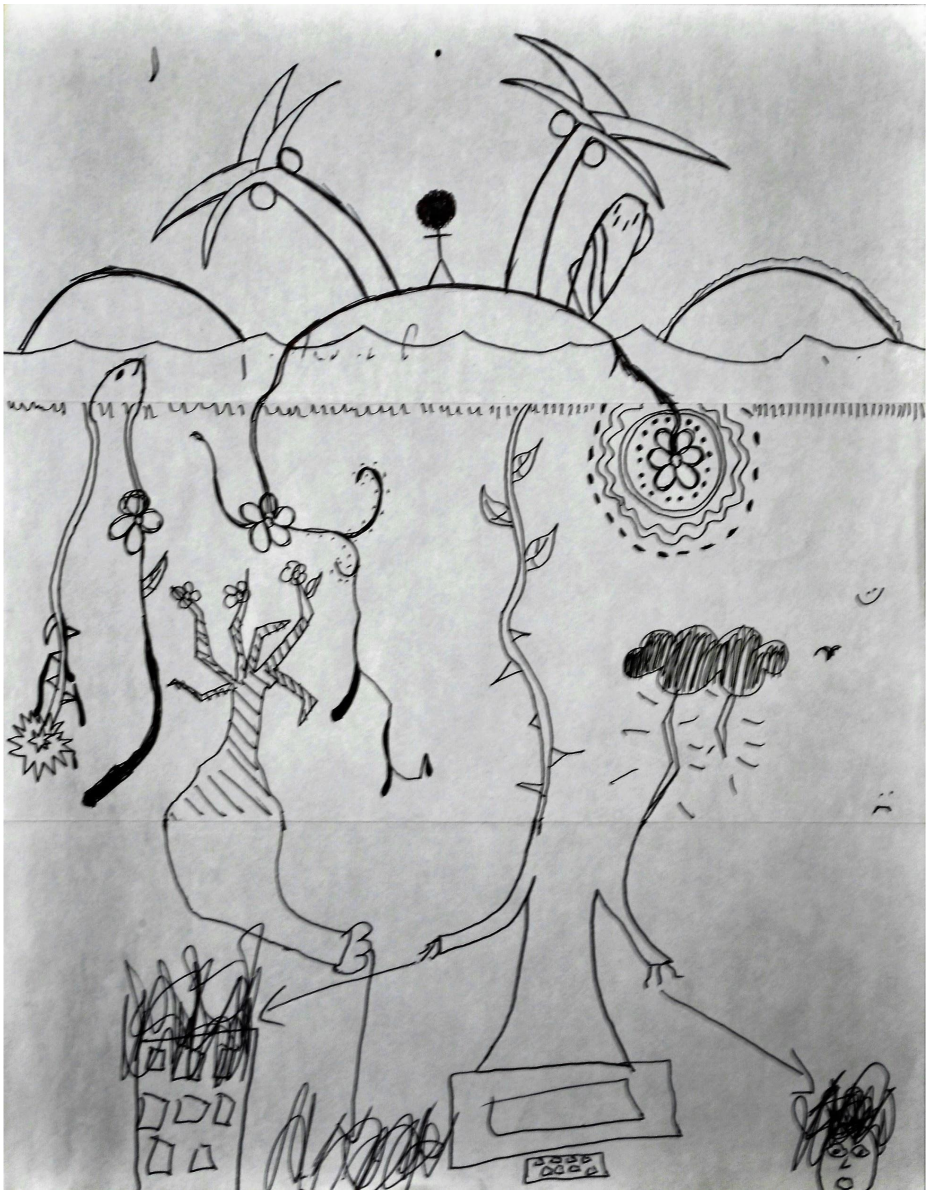

Figure 31: “Dystopia, Translation, Utopia 1”, an Exquisite Corpse drawing by the author and his students at Princeton University’s Center for Talented Youth, July 2014.

CHAPTER SIX:

a pedagogical overhaul

> Our tutors never stop bawling in our ears, as though they were pouring water into a funnel; our task is only to repeat what has been told to us. I should like the tutor to correct this practice, and right from the start, according to the capacity of the mind he has in hand, to begin putting it through its paces, making it taste things, choose them, and discern among them by itself; sometimes clearing the way for him, sometimes letting him clear his own way....
>
> ....We have been so well accustomed to leading strings that we have no free motion left; our vigor and liberty are extinct.
>
> - Michel de Montaigne, "Of the Education of Children" (1580)

My dissertation was never intended to conclude with a section engaged with questions of democracy, education and activism. Still, I feel incredibly lucky that my earliest writing phases overlapped with my earliest gigs as a course instructor for undergraduate and high school students. My first experience involved teaching an undergraduate STS course at York University, "Technology, Expertise and Society." The second was a whirlwind summer teaching enthusiastic high school students. I had the opportunity to offer an intensive course called "Science, Technology and Public Policy" in 2014 and 2015. The course was part of a camp for "gifted" students at Princeton University, operated through Johns Hopkins' Center for Talented Youth (CTY). CTY programs combine rigorous and interactive academic work with physical activity for students who find it hard to fit in with peers at their home schools. Many of these students are, what David Hanna (2017) calls, "double labeled." As he puts it, "in addition to being gifted they are also learning disabled and/or suffer from emotional, social or behavioral problems" (2017: 22). These students are managing anxiety, depression, autism and ADHD, not to mention the stigma of being labeled a "gifted" student in the first place.

This presents unique challenges for instructors who, “in most cases,” are not “equipped with the required knowledge or the support they need” (Hanna 2017: 22).

Part 3 is meant to close some loops *and* open up multiple pathways down which this dissertation might guide future research, teaching and activism. Part 1 was about what people say they are doing or desire to do in translational medicine at DMNB in Saint John. Part 2 provided a modest introduction to the kinds of models, experiences and environments people are envisioning and building to shape a supposedly better future for translational medicine at UCSF’s CTSI. The through line from Parts 1 to 2 was the simultaneously hollow and substantive ways in which people articulate the goals and challenges of translational medicine. Inherent to capital-intensive technoscience is never ceasing doublespeak (Pizzicini 2021). Research organizations increasingly produce hybrid experts and marketers, as much committed to the rigors of disciplinary science as the storytelling devices of public relations, fundraising and speculative experience design.

Part 3 is meant to elevate what I consider worth holding onto in the discourses and designs of translational medicine. What better setting for this kind of work than classrooms with high school and undergraduate students from around the world? What better partial perspective (Haraway 1991) than that of a teacher/lunch room monitor/mentor learning to work and care with a bunch of teens embodying personal, social, emotional, political and economic tensions quite similar to those that drive the most compelling STS work?

So, Part 3 extends concerns laid out in Parts 1 and 2 about discourse, design and deliberation, but with a much different focus. Inspired by the push towards “engagement” in STS education and feminist approaches to enactment STS research, Part 3 centers on the development and deployment of a novel ethnographic and pedagogical tool that I have called “Science Court.” Science Court is a role-playing game, designed to help students imagine how to empower non-scientist citizens (people like themselves) to become decision-makers when it comes to how particular technoscientific projects should be supported. I used the discourses and designs of translational medicine to transform the classroom into a courtroom, though not the kind you might be imagining. If my goal has been to “stay with the trouble” *and* take seriously how the world “could be otherwise,” Science Court represents necessary compromises between the realistic and the radical in attempts to transform the technoscientific status quo.

Part 3 presents the most direct contribution I hope to make to STS as a field of research, practice and accountability: new ways of bringing STS into K-12 and undergraduate classrooms. I contribute to ongoing debates about how to balance the theoretical and activist spirits of two broadly conceived branches of STS. These have been problematically labeled “high church” (science and technology studies) and “low church” (science, technology and society) (Fuller 1993, 1997; Sismondo 2008) STS. As Sergio Sismondo has suggested, “[t]here is undoubtedly considerable distance between the more ‘theoretical’ and the more ‘activist’ sides to STS, but there are plenty of overlaps between theory and activism” (2008: 20). My interest is in overlaps between theory and activism not in research but in education. Specifically, how can a balance of theory and activism engage students in fostering new understandings of “science literacy”?

Framing Part 3 within STS ED represents the most explicit attempt at deliberative ethnography in this project. This is only possible because of the timing of opportunities afforded me in 2013 and 2014. I was in the thick of fieldwork in Saint John and San Francisco when I was asked to interview for a teaching position with CTY. I was delighted when I was told that I could focus my version of “Science, Technology and Public Policy” on areas of personal interest and specialization. I was afforded a chance to make my teaching experience simultaneously a research experience *and* a context-making experiment (Asdal & Moser 2012; Fortun 2012). Science Court became both enactment and ethnography.

Here I am purposefully collapsing perceived borders between my roles as researcher, teacher, frustrated taxpayer and activist. From the beginning, I set out to say something about how we all, scientists and non-scientists alike, need to work to build *our* collective biomedical futures. It is in my own role as translator, as a hybrid ethnographer-STS scholar-teacher, that I feel most capable of offering something practical towards this goal. Part 3 provides not a rehash of this dissertation’s core arguments, but an attempt to show how STS can be used to critique and reshape, at least in a single classroom, the driving discourses and designs of technoscientific innovation.

Translational medicine has long been, though not exclusively, described as a path by which the public might become fully involved in making decisions about whether and how to support biomedical research. Yet, the discourses and designs of translational medicine that I observed in Saint John and San Francisco paid little more than lip service to this end. Across both sites, I found very few guiding principles for bringing non-scientist citizens into the inner sanctums of decision-making (Gohar et al. 2018), as they had different and sometimes competing notions of translation at stake.

In Part 1, I highlighted the ways in which discourses of translational medicine emphasize the importance of community building and empowering patients. The problem I addressed is that too often “community” refers only to experts and business leaders, rather than non-scientific publics meant to benefit from biomedical translations. In Part 2, a similar situation unfolded, in terms of the ways in which non-expert publics were designed *out* of *UCSF 2025* and the CTSI funding retreat. Overcoming this, to me, requires a profound overhaul of the pedagogical tools used to teach technoscience and medicine at all levels of age and ability. So, rather than simply restating my frustrations with translational medicine, here I experiment with actively doing and teaching it.

Translational Medicine’s Emerging Pedagogies and “Radical” STS ED

In the early 2010s, a number of academic institutions began developing full graduate programs in translational medicine. Others, like DMNB described in Part 1, tried to subtly integrate principles of translational medicine into all facets of a student’s medical training. Yet, the question remains: what would it actually mean to “train” someone in biomedical translation, beyond the narrow frameworks I witnessed in Saint John and San Francisco?

One of the most complete visions for a fully integrated approach to teaching translational medicine came from the University of Alberta. In 2012, the U of A announced that they were developing Canada’s first “[c]omprehensive training program in translational medicine” (“DOM” 2013: 1). For the U of A’s Department of Medicine, translational research required new ways of thinking about “all stages of the journey” from animal labs to the “point that government approves and pays for the resulting therapy on humans” (“DOM” 2013: 2). The program would be made up of two “tracks”: the academic track and the “industry (biotech and pharma) and government” track

(“DOM 4). The impetus for this new program was a sense that translational medicine required a complete restructuring of clinical training, research and teaching. These domains needed to be flexible, customizable and interdisciplinary (“DOM” 2013). The university suggested that although practicing physicians, clinicians and animal researchers had recognized the need for new partnerships between “academia, industry and regulatory bodies,” this realization had yet to significantly impact medical education. For the U of A, if translation was here to stay as a category and mode of research, then they had to work out new approaches to teaching medical students how to foster public and private partnerships, while remaining flexible in their research goals and bedside practices. Of course, once again, we see a “comprehensive” take on translational medicine that falls well short of adequately addressing and collaborating with the publics and communities meant, at least on paper, to benefit from innovative translations coming out of both academia and industry.

To overcome this, I suggest that the emergence of “comprehensive” programs in training translators of biomedicine also requires new ways of preparing and recruiting medical students from K-12 and undergraduate education. This means rethinking how students of all ages are introduced to medical research and practice. What kinds of literacy are required to guarantee that the next generation of translators are adequately prepared for the complexity and indeterminacy of biomedical futures? These futures, as previous chapters have suggested, will unfold alongside new ways of negotiating scalar connections and ambitions between the local and the global and, as a result, new frameworks for thinking about nationalism, citizenship and democracy (Erikainen & Chan 2019; Gonzalez-Polledo 2018; Rajan 2006, 2017). What role might STS play in reshaping how biomedicine is framed for future scientists and nonscientists alike? How might STS contribute to reimagining how technoscientific medicine can and should be taught, and how students will be asked to engage in questions about the social, political, environmental and economic implications of technoscientific innovations and policies?

So-called low-church STS has been an important, if not universally embraced, component of elementary and high school science education in North America since at least the 1980s (Roy 1984; Gorur et al. 2018; Kumar & Berlin 1998; Mansour 2009). In the United States, STS education reforms (STS ED from here on out) have been championed as necessary for providing "science literacy" to all students (Devi & Aznam 2019; Fensham 1985; Aikenhead 2003). "Science literacy" has had a long and complicated history, one that overlaps with the nationalist rhetoric of the Cold War as well as the emergence of what can broadly be called "risk societies" (Beck 1992; Waks & Prakash 1985). STS ED has been championed by governments, researchers, teachers and school boards for decades, yet the movement is anything but coherent. My work aligns directly with a group of self-proclaimed "radical" STS ED proponents. These reformers have encouraged a brand of "critical" and "socially responsible" science literacy that they believe is vital to scientists and non-scientists determining what technoscientific innovations and policies to pursue. How might we approach designing pedagogical exercises for fostering this critical science literacy? How can STS ED engage and "activate" publics to participate in making decisions about how and whether to support novel technoscientific innovations and policies?[46]

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[46] As both an interdisciplinary ethnographer and a teacher, I want to consider how democracy, citizenship and participation are framed and understood in STS ED. My goal is to highlight not just the importance of specificity when these concepts are used, but to question how STS ED might look in contexts that are decidedly non-democratic. STS ED has begun to travel, to places like Cuba and Egypt, where "democratic participation" is not always the end goal, or at least not a realistic consequence of STS ED reforms. There is emerging a serious "center and periphery" divide that challenges those of us in STS *and* STS ED to rethink our assumptions and postures towards democracy, citizenship and meaningful public participation (Cerezo & Verdado 2003; Mansour 2007).

I argue that STS ED has been informed by an overly narrow understanding of scientific and technological literacy. As a suggested remedy, I introduce the concept of “institutional literacy.” I call for STS ED to increase emphasis on training students to better understand the bureaucratic frameworks, public-private partnerships and peer review structures that shape how biomedical research is conducted. Combined with an accessible engagement with social studies and political theory, I think this is one way of fostering a future generation of scientists and non-scientists alike who appreciate the complexity, uncertainty and context-dependency of technoscientific labour and its broader sociopolitical implications.

One answer to the question “what could translational medicine become?” requires differently prepared patients and publics upstream. In short, translational medicine’s discourses, designs *and* pedagogies need to remain productively entangled with one another. As I’ve shown in earlier chapters, understanding what translation is and how it works in particular academic and geopolitical contexts is important, both in the interest of recruiting the next generation of biomedical translators and in fostering a kind of scientific literacy that appreciates institutional frameworks that make biomedical research possible in the first place. These are the kinds of concerns Science Court is meant to modestly address.

Building My Own Pedagogical Sandbox

At Princeton’s iteration of CTY, I was a combination teacher, camp counselor and mentor to 15 students per session. Each cohort of students was with me for three and a half weeks. Duties involved teaching from 9am until 3pm and then again from 7pm until 10pm everyday but Saturday. Sundays only included the evening class. I was also responsible for monitoring students during lunch breaks. The intense teaching hours, and the fact that I had never previously developed a course for high school students, forced me to perform in a flexible and improvised manner. My syllabus was a shapeshifting mix of theoretical texts, recent newspaper and blog stories, films, and a wide array of interactive exercises. Many of these were developed in the wee hours of the morning before class. The syllabus I produced was also informed by my recent "Technology, Expertise and Society" course at York University, and past iterations of this particular CTY course.

I realized quickly how much I had taken for granted in my STS training. So many theoretical frameworks and approaches to defining how and by what means technoscience is produced seemed self-evident to me. Yet, in previous versions of CTY's "Science, Technology and Public Policy," there was nary a hint of social construction, of theoretical *and* practical tools for helping students navigate the broader cultural, political and ethical dimensions of technoscientific policies and controversies. Sure, controversies were there (Bhopal, Tuskegee, vaccine debates, Fukushima, and the, at the time, recent factory collapse in Bangladesh) but not the rigour of the historians, anthropologists and philosophers I had become accustomed to.

I didn't want to drown students in book-length theories and ethnographies, I wanted to give them more than false binaries between good and bad science policy. My goal was to revamp the course by combining the previous iteration's texts on how science policy gets made with a range of examples from critical STS, anthropology, history, media studies and feminist theory. Rather than focusing on one geographic location, I tried to emphasize the importance of context by providing examples from all over the world. These examples came from democratic, totalitarian, socialist and other geopolitical settings. The goal was to get students to think about how science is made, how policy is made, but also what role they might one day play, as global citizens, in shaping policy within and without technoscience.

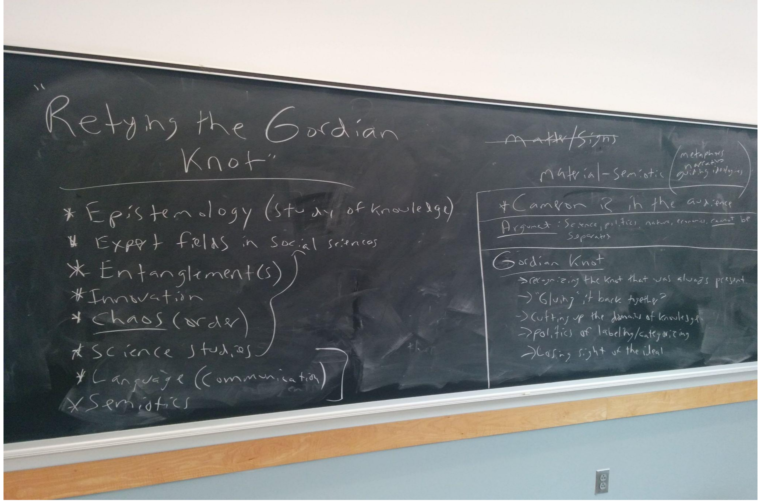
This approach was crucial because students came from around the world. They came from China, Singapore, Slovakia and Poland, along with those from across the United States. The diversity of students was impressive, given that there were only 15 in total in each session. I was further relieved to find out that at least 25% of the students were on needs based scholarships. The CTY program is expensive, close to $10,000 per student back in the summer of 2014. The fact that at least one fourth of the students in my class came from less socio-economically privileged backgrounds felt at least *somewhat* like a step in the right direction.

Overall, the course was a breath of fresh air after teaching “Technology, Expertise and Society” to fifty or so checked out undergrads during the previous semester at York University. I take responsibility for much of what failed to resonate in that course. This course at Princeton helped me troubleshoot some aspects of that previous teaching experience, and allowed me to take full advantage of a smaller classroom made up mostly of students who enthusiastically volunteered for three weeks of summer school.

The class felt like a dynamic fourth year undergraduate seminar. University level material filtered through activities appropriate for high school students. Lectures, videos, drawing exercises, role-playing games, short papers, presentations, and rich discussions about a range of topics. The students never hesitated to complain when activities failed to fully engage them, but they seemed pleased with the course overall.

We traveled the globe: visiting the Fukushima nuclear disaster of 2011, the Bangladesh factory collapse of 2013, the AIDS epidemic in the United States and Africa, the sustainability movement in Singapore, the media landscape in China and Hong Kong, the anti-vaccination movement in the United States, and the so-called “death of evidence” in Canada under the Harper government. It was a whirlwind. Throughout, I had students read excerpts from a number of STS scholars, as well as feminist researchers, philosophers, designers, historians, political theorists and economists. I really wasn’t sure how the students would take to these materials, but I endeavoured to give them brief excerpts, detailed lectures and a range of exercises to help them foster a sensitivity to the messy conditions that generate scientific knowledge and policy.

In the first few days of the course, we read excerpts from Donna Haraway, Karen Barad, Bruno Latour. I introduced concepts, metaphors and aphorisms like Charis Thompson’s ontological choreography, Haraway’s partial perspectives, Perrow’s normal accidents, Latour’s Gordian knots, and the unique (and frustrating) ways in which Collins and Evans problematized the notion of expertise. We delved deep into questions of human and nonhuman agency, all of which were used to challenge and elevate what policy is and how it might be better made and shared in technoscientific societies.



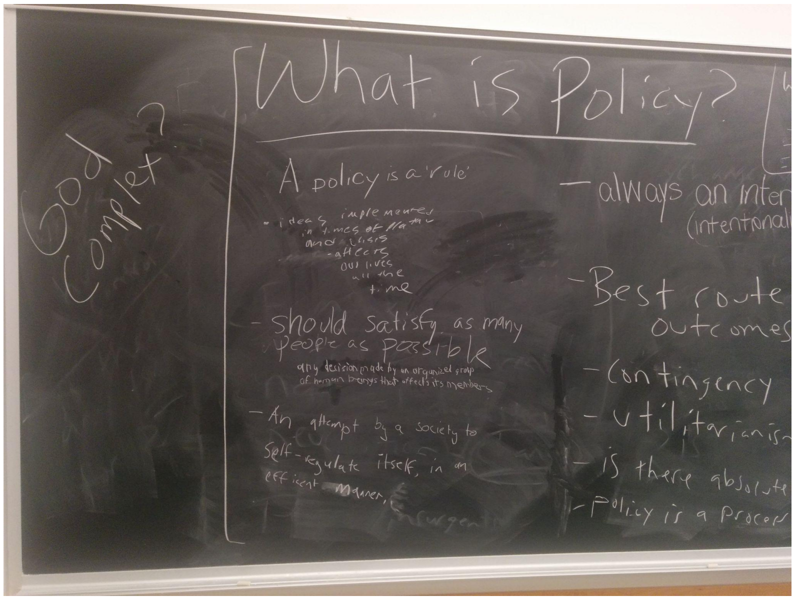
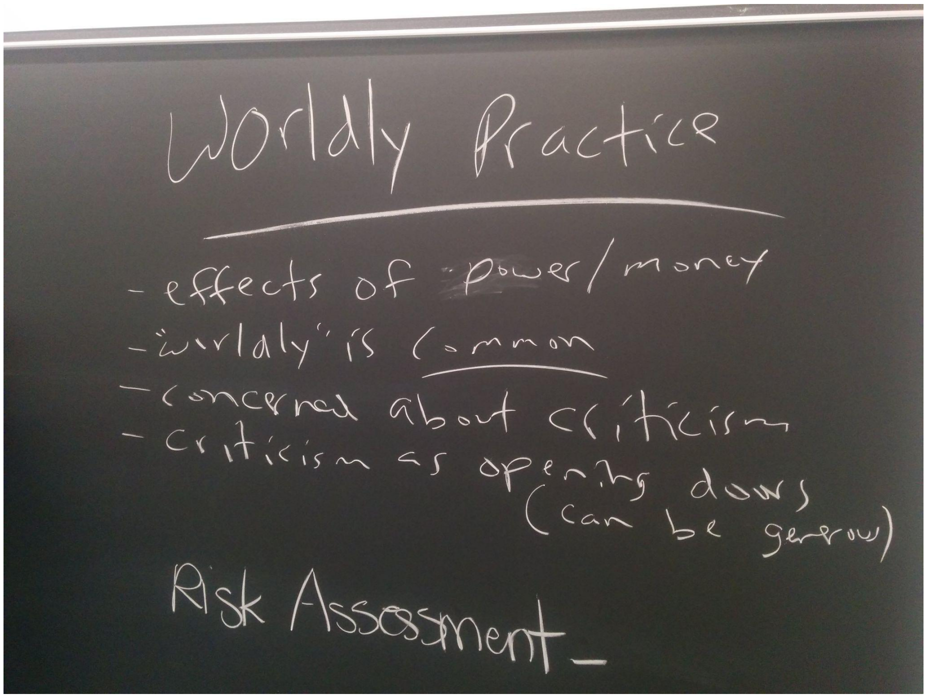


Figure 32 and 33: "Retying the Gordian Knot" and "What is Policy?" Photo by author.



Worldly Practice

- effects of power/money
- "worldly" is common
- concerned about criticism
- criticism as opening doors (can be generous)

Risk Assessment_

Figure 34: "Worldly Practice." Photo by author.

Figure 35: "So, is this the Grandfather or Godfather of STS?" Photo by Author.

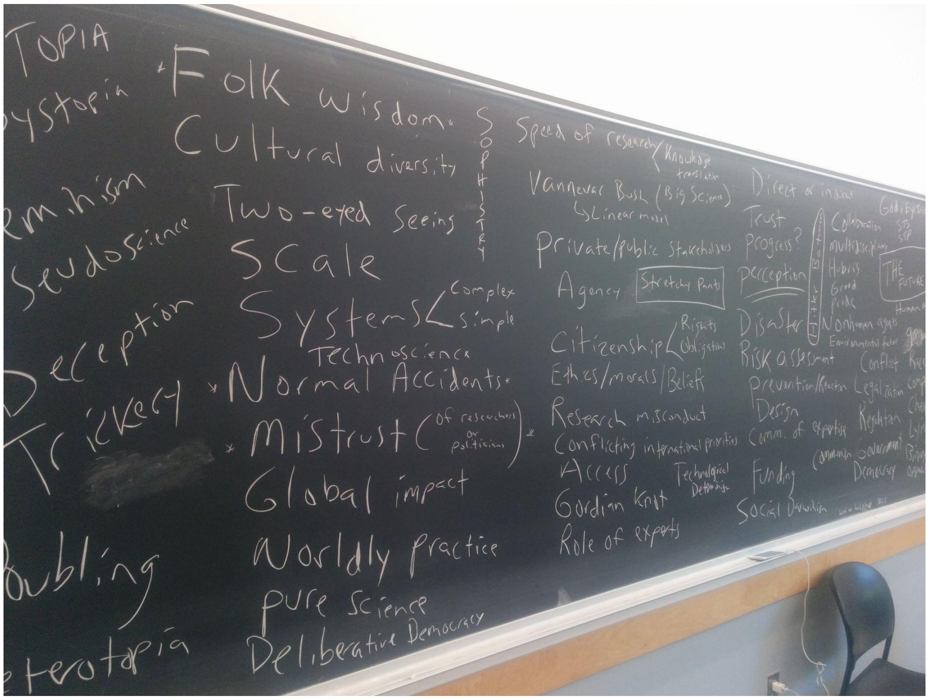


Figure 36: "End of Term Concept Dump." Photo by author.

It became important to try to simultaneously introduce students to the radical contingencies of technoscientific policy *and* offer compelling accounts of specific sites of knowledge production and dissemination. This is where Science Court and my understanding of both science and institutional literacy came in.

PUNCTUM 3:

pedagogical improv

It is 6:00am on a hot, humid Wednesday morning in late July 2014. Into the second week of my first summer teaching at CTY and the early morning scramble has become a critical part of my routine. Syllabus? What syllabus? Sure, I have a document labeled “syllabus” that I developed in the weeks prior to the first class, but it has become an unrecognizable Frankenstein’s monster, a mess of neverending edits and additions of new articles, activities and assignments. This, I have been told by more experienced instructors, is par for the course at CTY. The students have no filter when it comes to expressing when they are becoming disengaged. If something isn’t captivating them, capturing and inspiring their imagination, they will revolt. Syllabi become living, breathing creatures, and panicked early morning rifling (physically and digitally) for the most compelling scraps the norm.

On this particular morning, I am trying to figure out how best to introduce students to translational medicine. Having experienced a less than successful introductory class in Saint John the previous fall (described in Part 1) I am well aware of what I do not want to do. I have to appreciate that, on the surface, translational medicine can be a murky, confusing and, let’s be honest, boring subject. Then, as now, my interest was in what lies beneath that surface. I wanted to excite and frustrate these students as much as I was excited and frustrated coming out of fieldwork in Saint John and San Francisco. How could I get them to see translational medicine as a rich and troubling framework in which they could think about challenging expert and non-expert dichotomies, to see themselves as potentially part of the procedures by which decisions about biomedical translations get made?

Talking with my teaching assistant, Christina, the night before, she was reminded of a paper written by her thesis supervisor at the University of North Texas, Adam Briggle. She had glowing things to say about his three-pronged role as academic, columnist and activist. His work as a philosopher of science was inseparable from his attempts to fight against the fracking industry in Denton, Texas. Christina and I had actually sat up late two nights prior, in the commons area of our Princeton dormitory, watching a livestream from Denton's city hall. Briggle and hundreds of other locals–from shopkeepers and daycare workers, scientists and social scientists from the University of North Texas, to priests and people only identifying themselves in relation to chronic health issues–were there to push for radical reforms to fracking. Briggle and two others had spearheaded the campaign, which began by trying to better inform Denton residents about the human and environmental risks of fracking. It quickly shifted to an initiative geared towards empowering everyone to have their say in eradicating the industry.

Briggle's lack of interest in separating his expertise and research from his responsibility towards fellow citizens is important. Briggle struck me immediately as someone whose approach to and understanding of science literacy and citizenship might yield useful insights for people concerned with how to bring critical STS theory into K-12 education. So, I took Christina's advice and, before bed, read a short paper of Briggle's, "Science Policy and the Expectation of Health," that she thought would help kickstart the next morning's scramble for a compelling activity to introduce students to translational medicine.

Making Science Court on the Fly

Briggle is a philosopher, but I was impressed with just how accessible and easy to digest his writing was. Theoretically rich and informed by rigorous research practices, the piece also possessed the clarity and concision of good journalism. It was no surprise to find out that Briggle long worked as a columnist for newspapers and online magazines, publishing expert opinions and news items for *The New York Times*, *Slate* and *Salon*.

In this particular article, Briggle moved carefully between theoretically dense concerns about citizenship, activism and American democracy, and easy to parse statistical evidence and real-world examples. The goal of the paper was to offer an accessible critique of how healthcare research gets funded in the United States. Focus was on the NIH's two phase peer review process for funding allocation. His was a particularly convincing critique of the second phase of this process. Briggle (2012) outlines how Phase 1, where scientists try to determine whether a proposal meets the standards of academic novelty and rigour, is privileged over Phase 2. In Phase 2, researchers debate whether and how a given proposal might impact both the health of the public and the health of the economy. Whereas Phase 1 has many steps and a rich description on NIH's website, Phase 2 is lacking in both detail and emphasis. Briggle thinks that this should be reimagined so that both Phase 1 and Phase 2 receive the same level of attention and concern. At the end of the piece, he provides the following suggestion for how to resolve these problems:

> One way to make this beneficent censorship both practical and democratic is to **transform the second stage of peer review into a science court**. **This court would judge the societal worth of all proposals that pass the first stage with a fundable score.** The principal actors would be the prosecutor, the defendants, and the jury. Its essence would be an open challenge, wherein the prosecutor throws down the gauntlet by arguing that the proposed research will not improve public health. The prosecutor would represent the

> interdisciplinary moment in the peer review process, because his or her expertise would not be that of the research proposal under consideration. It would, rather, be a mixture of economics, ethics, sociology, and whatever else is needed to make a reasonable, well-founded, pessimistic case regarding the interface between the proposed research and society (2012: 323).

After reviewing and summarizing the article for my upcoming morning lecture, I couldn't get this suggestion out of my head. It occurred to me that this piece deserved more than a novice instructor reading summary notes *at* the class. I'd still lecture, but then it was time to *do* something: it was time to develop a mock science court.

In Briggle's framework, a science court would be as much about improving human health as it would be avoiding spending unnecessary money. It was also about being more open with the public about the goals of new research projects, so that social, cultural, political and economic concerns could be put forward *before* a project gets underway. The only way to do this, of course, is to generate participatory democracies made up of people who are literate not just in science, but in questions of the relationship between science, technology and society. At the same time, this informed citizenry would have a general understanding of how research in a particular political system gets funded. Whether or not this is possible is another question, but my Science Court exercise would be designed to get students to actively deliberate, rather than merely ask, these questions.

Obviously, one article is not going to make all of these ambitious goals achievable, so I altered my lesson plan, delaying my introduction to Briggle by a day. In what follows, I want to highlight some of the material I presented to these students. In a funny way, Briggle's single paragraph thought experiment transformed my goals for the rest of the summer session, and was the centerpiece of my second year teaching at CTY. I would use this as an opportunity to account for what I found most troubling and confusing about the discourses and designs of translational medicine. The classroom would become a field site and a stage. This was, in my mind, exactly what Kim Fortun (2012) and Asdal & Moser (2012) had in mind when they talked about deliberative and context-making postures driving future-forward and experimental ethnographic research. Why not teach and conduct research at the same time? Why not test my ideas and concerns with a bunch of enthusiastic students who wanted, *needed*, to be challenged and engaged in unique ways?

Context Over Content

First and foremost, my goal was to get students mindful of the fact that where and how science happens is important. This is crucial to Briggle's, and my own, argument that what is missing from models of "science literacy" is an appreciation for the peer review processes and funding systems that allow scientific, technological and medical practitioners to do their work. I agree that people should become more aware of basic scientific principles and the possible effects of particular scientific projects on society, the economy and the environment. At the same time, however, it is important to remain sensitive to the contexts in which a particular research project is being developed. For instance, how does a particular country go about determining what projects to fund? Is there a peer review process at all?[47] In a democratic society, we might assume as much, but what about how totalitarian nations determine what projects to support? What voices get to be heard and which are ignored in these contexts? It is also important that we don't make blanket statements about "democracy." No two democracies look alike, to say nothing of equally valid questions about whether there exist any truly democratic

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[47] Melinda Baldwin (2018) has highlighted the ways in which peer review in the United States, both in terms of scientific journals and funding bodies like the NIH, emerged alongside the Cold War. The

societies at all. In the United States, peer review, both at scientific journals and research funding bodies, emerged during the Cold War (Baldwin 2018). The rise of peer review was in part a response to a series of debates about whether and how taxpayers should be able to hold researchers accountable. Unsurprisingly, a self-important subset of scientists argued that only experts should be allowed to judge the rigour and value of the work of fellow experts. As Melinda Baldwin puts it:

> In the 1970s, in the wake of a series of attacks on scientific funding, American scientists faced a dilemma: there was increasing pressure for science to be accountable to those who funded it, but scientists wanted to ensure their continuing influence over funding decisions (2018: 1).

As is often the case, the public embraced this argument, eventually elevating peer review as the only sure way to guarantee the legitimacy of scientific labour. The "peers" in peer review were assumed to be *expert* peers, rather than broader peer groups that shape diverse publics. For Baldwin, the successful campaigns to establish peer review in this manner meant that for both experts and non-experts alike, it was assumed that "[t]aking funding decisions out of expert hands…would be a corruption of science itself" (2018: 1). Science Court was designed to help students break down the expert/non-expert binary as early as possible in their education, to challenge who counts as peers and who, ultimately, should make up the decision-making communities.

Utopia, Dystopia, Heterotopia and Translation

First and foremost, I decided to help students flesh out some of the concepts that Briggle used in his article. I also introduced new concepts that I thought would better prepare them for participating in a version of Science Court focused on translational medicine. The two day lesson that preceded Science Court was titled "Utopia, Dystopia and Translation." The lesson began with a self-reflection and mind-mapping exercise on the concept of utopia. Each student was asked to write what utopia meant to them and what their personal utopia might look like. When we reconvened, students shared their utopian societies. The chalkboards quickly filled up with a wide array of approaches to organizing society, for thinking through how to make everyone happy, healthy, productive and emotionally fulfilled.

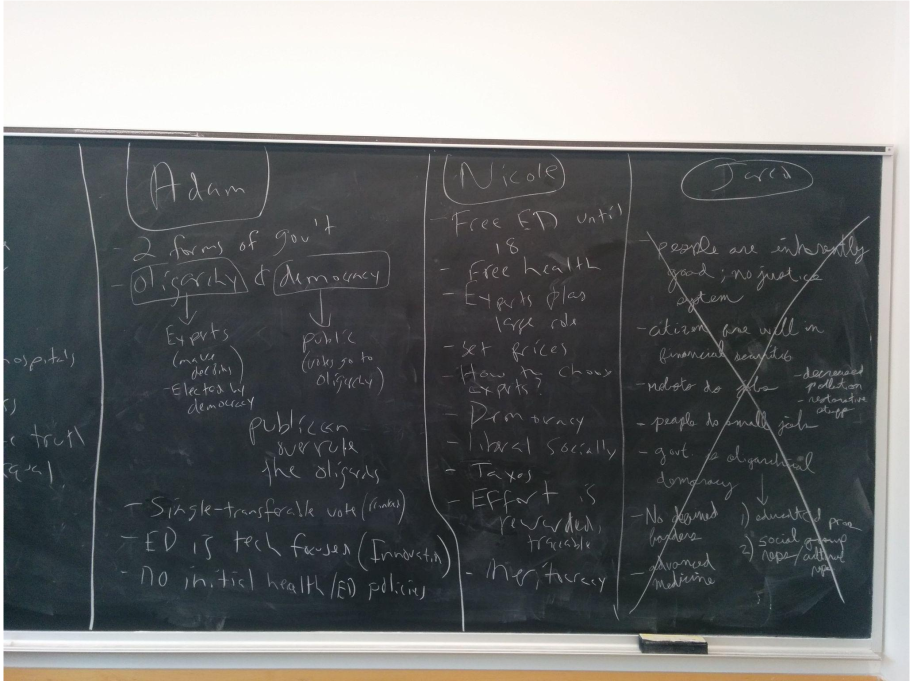

Figure 37: “My Utopia 1.” Photo by author.

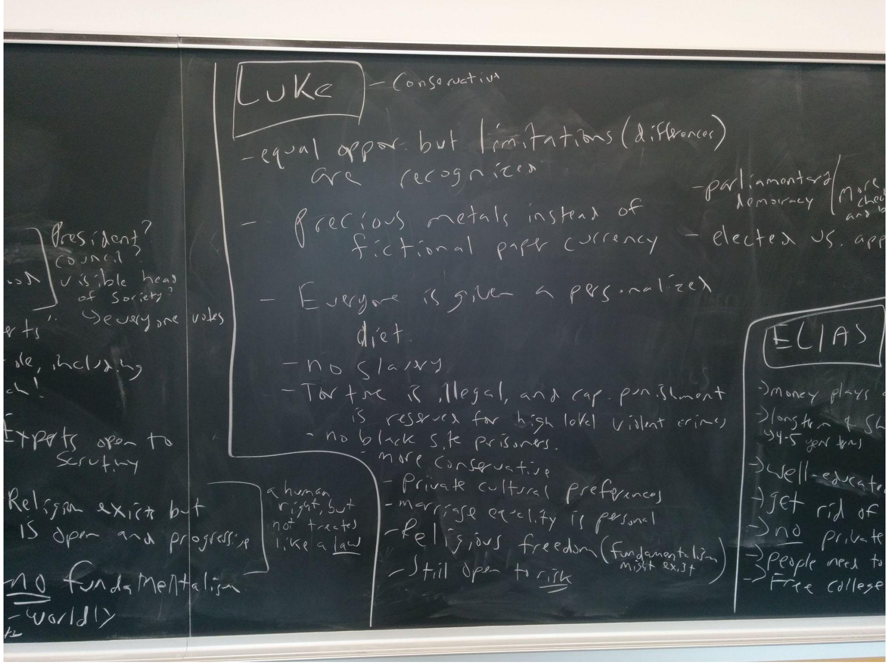

Figure 38: "My Utopia 2." Photo by author

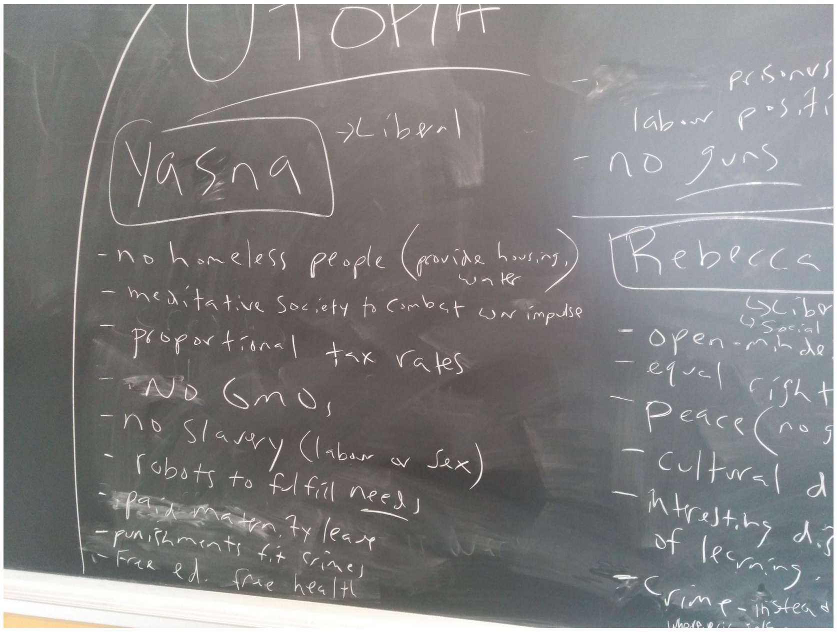

Figure 39: "My Utopia 3." Photo by author

Many students developed socialist utopias, where everyone had guaranteed and equally distributed jobs, income and resources. These societies took on a form of what Durkheim (1893) would have called "organic solidarity." On the other hand, some students acknowledged that their utopias looked more like authoritarian or totalitarian regimes, with clearly defined socio-economic hierarchies and definitive individual or collective leaders. Many more believed that their utopias were "democratic," though how these democracies were organized was so diverse that students immediately recognized the importance of avoiding talking about capital-D democracy.

One student's written submission highlighted the value of having introduced key STS theories and case studies earlier in the course. The nuanced ways in which expertise and citizen engagement were framed, without prompting, gave me a sense of encouragement:

> Experts would play a large role in running society; but part of their job would be public outreach. By helping to inform the public, an expert should have more of an inclination to share the truth. Experts would be open to questions and the public would be open and have enough knowledge to question the experts. (From a student submission, July 2014).

We did a similar exercise for the concept of "dystopia" after which I asked the students to tell me what they think of when they hear the word "translation." Students offered a wide range of answers, emphasizing the importance of translation in literary and linguistic domains. After a rich discussion, I had them get into groups of three and develop exquisite corpse drawings.[48] This is an exercise we had done for each of the course's previous units, but this time it was more theoretical than practical. The head was to be one student's idea of "utopia". The feet were to be one student's idea of "dystopia" and the body was to be one student's idea of "translation".

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[48] According to MoMA's homepage, exquisite corpse is a: "…a collaborative, chance-based drawing game known as the exquisite corpse, Surrealist artists subjected the human body to distortions and juxtapositions that resulted in fantastic composite figures. This exhibition considers how this and related practices—in which the body is dismembered or reassembled, swollen or multiplied, propped with prosthetics or fused with nature and the machine—have recurred in art throughout the 20th century and to the present day. Artists from André Masson and Joan Miró to Louise Bourgeois and Robert Gober to Mark Manders and Nicola Tyson have distorted and disoriented our most familiar of referents, playing out personal, cultural, or social anxieties and desires on unwitting anatomies. If art history reveals an unending impulse to render the human figure as a symbol of potential perfection and a system of primary organization, these works show that artists have just as persistently been driven to disfigure the body."

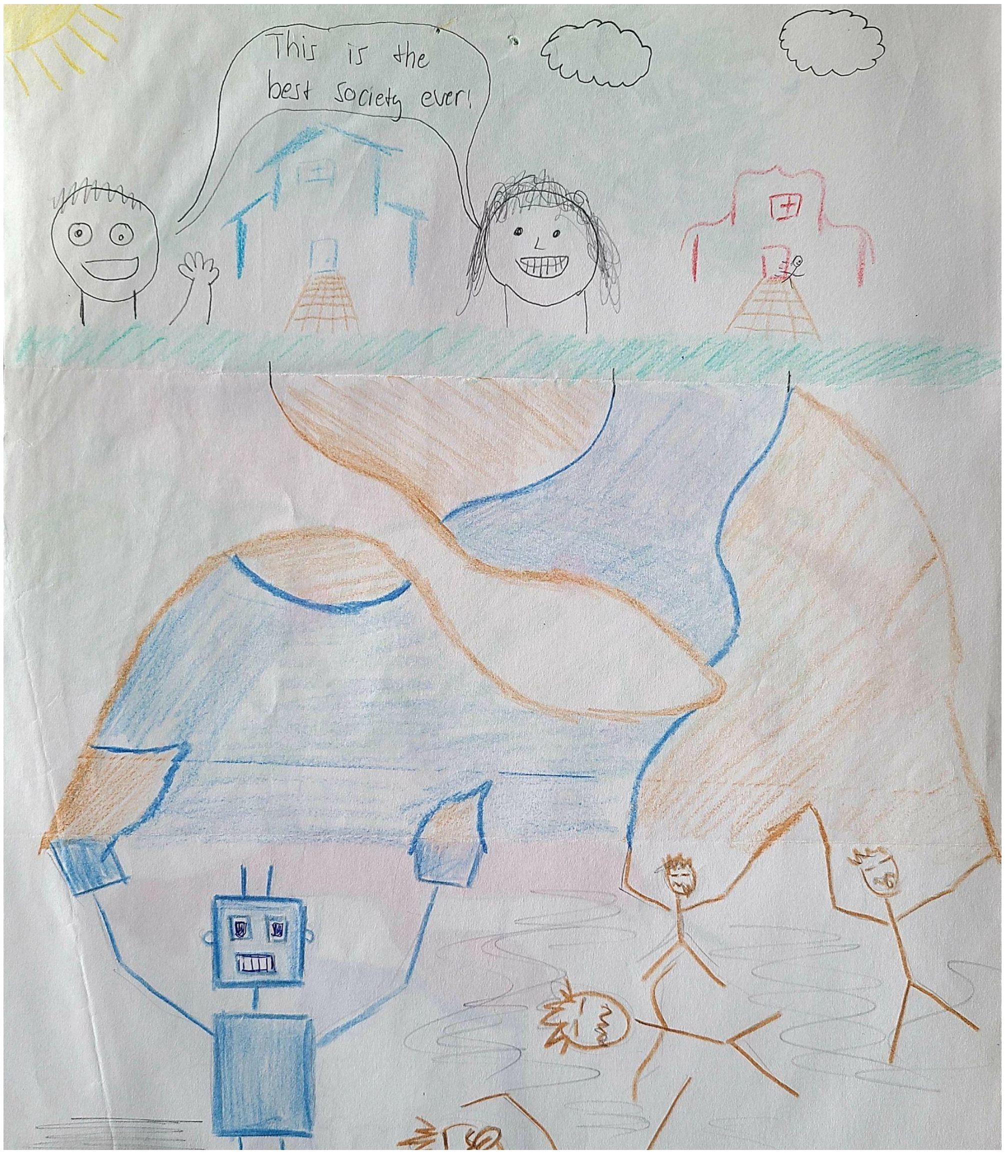

Figure 40: "Dystopia, Translation, Utopia 2", an Exquisite Corpse drawing by the author and his students at Princeton University's Center for Talented Youth, July 2014.

Figure 41: "Dystopia, Translation, Utopia 3", an Exquisite Corpse drawing by the author and his students at Princeton University's Center for Talented Youth, July 2014.

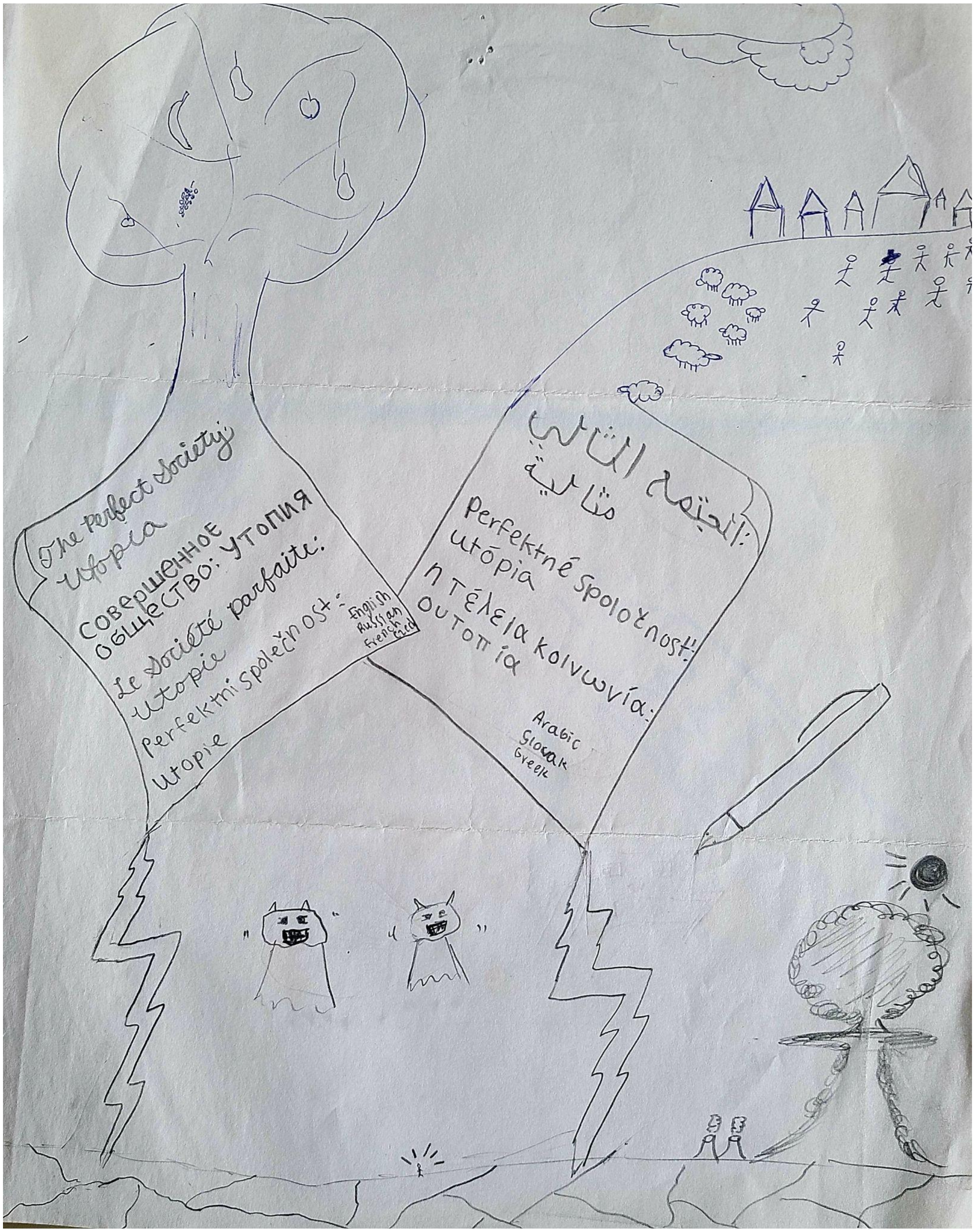

Figure 42: "Dystopia, Translation, Utopia 4", an Exquisite Corpse drawing by the author and his students at Princeton University's Center for Talented Youth, July 2014.

The resulting images are compelling for a number of reasons, most notably for how they directly and indirectly address the politics inherent to translation of all kinds. Between utopia and dystopia there exists a messy middle through which people try to connect across differences. Whether these differences are cultural, social, economic, or disciplinary doesn't change the fact that translation is both imperfect *and* necessary. This is why we can never fully achieve utopia or dystopia, as there will always be a remainder, a path down which to try again, to challenge ourselves to make the world otherwise, for better or worse. After this drawing exercise, I presented an interactive lecture that would lead into Science Court. The lecture summarized Adam Briggle's article, but also provided detailed definitions of utopia, dystopia, heterotopia, translation and translational medicine.

Adam Briggle: "Science Policy and the Expectation of Health"

Briggle begins his piece by describing Francis Bacon's 1626 utopian text *New Atlantis*. Before going into a more thorough summary of Briggle's article, I thought the students would benefit from discussing the idea of "utopia" a little more. I asked them to think about utopia in answering the question: "what kind of world can or should we strive to build for ourselves and, ultimately, what role might each of us play in shaping such a world?" This led into a broader back and forth discussion about utopia and dystopia, framed around each word's etymological definition:

> *Utopia*
> 1551, from Modern Latin *Utopia*, literally "nowhere," coined by Thomas More (and used as title of his book, 1516, about an imaginary island enjoying the utmost perfection in legal, social, and political systems), from Greek *ou* "not" + *topos* "place" (see ***topos***). Extended to any perfect place by 1610s. Commonly,

> but incorrectly, taken as from Greek *eu-* "good" (see ***eu-***) an error reinforced by the introduction of ***dystopia***.
>
> *Dystopia*
> "...imaginary bad place," 1868, apparently coined by J.S. Mill ("Hansard Commons"), from Greek *dys-* "bad, abnormal, difficult" (see dys-) + utopia
> (From the *Online Etymological Dictionary*).

I was particularly excited to use utopia and dystopia as a way of articulating the confusing relationship between fact and fiction in technoscientific discourses and designs. The students had already been introduced to the work of Haraway, Latour, Barad, Flusser and Fortun in the previous week. They were proving adept at navigating the ways in which utopia and dystopia are used in fictional writing, especially works of science fiction that attempt to forecast a future towards which humans might actually be moving. In my lecture notes, I expressed how:

> ...utopias are represented as perfect or near perfect, and dystopian texts are full of destruction, famine, sadness and often involve a future in which the large technological systems designed by humans have "taken over". Significantly, both utopias and dystopias are not *real* places. They both refer to imagined, and some might argue exaggerated, places, spaces and societies (From lecture notes, 2014).

From here, I began to ease into a broad introduction to translation and translational medicine, using utopia, dystopia and Briggle's article as anchoring points.

Briggle emphasized that, in Bacon's *New Atlantis,* a group of shipwrecked sailors on the island of Bensalem receive mysterious pills that cure them of their ailments very quickly. For Briggle, Salomon's house in Bensalem is a place where "health is an expectation," where science is understood as the driver of social progress. The sailors are not "scientifically literate" but merely trusting of the scientists and medical practitioners administering treatment. For Briggle, Salomon's house is a precursor to "our current spectrum of basic, translational, and clinical or applied research" (2012:

316). Briggle's point was that, since at least the mid-1940s, research in North America, particularly in the United States, has been driven by a belief that human progress stems from scientific and technological progress.

NIH and the Linear Model

Briggle makes clear how, at least in the United States, the foundations of the progressive, linear model of science and innovation were based on Vannevar Bush's *Science: The Endless Frontier*. I paused and asked the students to describe what comes to mind when they think of a linear model. They immediately picked up on resonances with a class from the week prior, where we talked about ANT and feminist science ideas about grand narratives of progress, situated knowledge and networks of technoscientific knowledge production. One student eagerly yelled "determinism" at my question, pointing towards catchy STS hooks that can be compelling to all age groups.

I further explained that, based in part on this so-called linear model, the pace of research in the United States increased significantly, as well as the amount of money being pumped into research organizations, medical schools and affiliated hospitals. Briggle referred specifically to the NIH as a modern Salomon's House. As he put it, the NIH was officially established in 1930, but its history can be traced all the way back to the late 19th century (Starr 1982). During WWII the NIH was focused almost exclusively on military related research and treatment. After the war, and along with a number of other research institutions, the NIH began focusing more and more on the "war" back home in the United States, funding research to treat a number of diseases and other health issues. As Briggle suggests, the optimistic spirit of Vannevar Bush's "endless frontier":

> …fueled the post-World War II growth of NIH as its budget skyrocketed from $4 million in 1947 to $100 million in 1957 to $1 billion in 1974 to $32 billion in 2010 (2012: 317)

Briggle's brief overview ends with him explaining how NIH research grants led to the development of more and more research centers. Training grants also provided incentives for more and more researchers to enter biomedical fields of inquiry. As it became further and further specialized, more and more researchers were able to rise to senior positions. There was, however, a problem with the way this new organization was developing. Part of the problem was that the divide between basic and applied research was so vast that it made it difficult for basic researchers to communicate with the clinical researchers that were supposed to use basic research to develop, test and produce new drugs and treatment options (Briggle 2012; Keating & Cambrosio 2012; Starr 1982). The new model of medical research funding also left many people out of the funding loop. At the same time, physicians who had previously been allowed to conduct small research projects were left out of the running in a landscape dominated by increasingly specialized sub-fields.

Trying to add further context for students, I explained how there were also questions concerning the goals of research universities, and their relationship to the health and medical needs of the general population. I provided this quote from historian Paul Starr:

> Universities became the umbrella organizations for America's regional health centers, which instead of being organized around the immediate needs of patients, were oriented primarily toward research and training (1982: 361).

Bringing it back to Vannevar Bush and the linear model, we discussed major overhauls to the organization and funding of health and medical research in the United States.

Changes were inspired by unchallenged optimism, at least at the level of government rhetoric. It was stated time and time again that scientists, if left to their own devices, will, through the power of their innovations, make individuals and society at large healthier, happier and more productive. Once again, as Keith put it in Part 1, "translation just fucking happens."

This was, for Briggle, only one part of the story. The post-war period that led to the rise of the NIH also gave rise to an increased, and seemingly contradictory, skepticism about what Briggle (2012) calls a social equation, in which "more science equals more social good." Atom bombs and gas chambers and a whole range of failed and abusive clinical research trials made a lot of people concerned about simply granting power to scientists to determine whether and how their research should be funded. Questions began emerging about what role the general population might play in making these kinds of decisions. Significantly, this skepticism also informed movements to change science education, as North American school systems began emphasizing the importance of "scientific literacy" for all (Waks & Prakash 1985; Waks 1992). Again, these CTY students had already been engaged in a series of conversations about technoscientific controversies and disasters, with key figures in STS and affiliated fields adding depth and nuance. The goal was to get them to see the whole course up to this point coming to life, a critical point of transition into a role playing exercise geared towards making students decisive agents of change.

Peer Review

At this point, I paused and asked students how we might best sort good science from bad science. They were still just learning how to cope with the idea that there might be messier categories for dealing with how science is made and disseminated. Trying to work through their confusion, I emphasized how Briggle points out that what constitutes “good” or “the best” science is impossible to determine once and for all:

> First, it can be defined as that which a scientific peer group finds most intellectually promising for advancing a given field of research. Second, it can be defined as that which is most likely to contribute to the goal of improved health. The linear model would have us believe that the two definitions are equivalent. But of course they are not, because rather than furthering social goals, scientific research can, at times, be irrelevant to those goals or even contradict them (2012: 318).

To elaborate on this point, Briggle outlines the “two-stage NIH peer review process”. In the first stage, scientists judge the scientific merits of a project using five criteria:

1) Significance
2) Investigators
3) Innovation
4) Approach
5) Environment

At this stage, researchers are trying to determine if a project is likely to advance a particular field of biomedical research. “The best” science is determined in the second stage where researchers and public representatives try to determine whether a project is likely to contribute to the improved health of human beings. Briggle’s ultimate critique is that the second stage is, well, not very rigorous, certainly not as rigorous as the first stage. Briggle asks, if the NIH's whole purpose for existing is that they use science to better human health, then why is this second stage so lacking in details, steps and rigour? I offered the following summary of Briggle’s answer:

> The answer, for Briggle, is that the linear model is insufficient and meaningless. If it was useful then we would be left only with the benefits of scientific research, not the harm caused by large scale research projects designed by scientists left to their own devices. This harm is very real, and worth keeping in mind in the context of biomedical research. This harm, however, is not purely physical, it can

> also be social, political, economic, cultural and psychological. These are all things you'll need to consider in the Science Court exercise.
>
> Briggle's ultimate point is that, when all these factors are combined, the utopian ideal of the linear model of biomedical progress can never be achieved. Rather than linearity and utopia, we might need to use messier concepts to understand the benefits and pitfalls of current approaches to funding biomedical research (From lecture notes, July 2014).

Translational Medicine

At this stage I introduced translational medicine as a third category of research in North America. I emphasized how translational research is a problematic attempt to identify the goals and problems associated with large-scale biomedical research. I paused and asked students to tell me what translation is and how people do translation in everyday life. They, not surprisingly, highlighted how it works in language and literary contexts, but they seemed unphased, even excited, by my overview of the history and etymology of the concept.

I asked the students to continue pondering the concept of translation as we broke for lunch. In the meantime I had my teaching assistant completely reorganize the classroom, based on a little mock up I drew the night before. When students returned, we would begin embarking on two full days of Science Court.

CHAPTER SEVEN:

science court is now in session

The design and ultimate goal of my Science Court exercise should not be mistaken with those of *Science Court*, the Saturday morning cartoon that aired on ABC from 1997-2000. That show used a courtroom setting to explain and defend basic scientific principles, with defendants actively trying to prove the existence of gravity, explain the importance of simple machines, or the complexity of soil. My Science Court shares the goal of better explaining science to students, but my emphasis is much more on challenging backstage processes and institutional structures that are as, if not more, important than the basic principles underlying science itself. Still, for both my exercise and the late 1990s cartoon, the goal is improved literacy for non-expert publics, or, rather, people whose expertise is not directly tied to socially accepted professions. Courtrooms provide useful metaphoric settings because they help students recognize that, at least for a little while, decisions have to get made, and they have to be somewhat final. There is never going to be a perfect answer to any question, but decisions have to get made, not in the name of unfettered progress, but in the name of chipping away towards a future, hopefully one that is at least somewhat better than the present.

The Proposals

Students were organized into four groups. Each group was divided into two camps: the defense and the prosecution. Christina and I served as “attorneys” for the defense and prosecution. We used this language by way of convenience not necessity, to maintain some sense of familiarity for students, even if we weren’t playing the role of lawyers exactly.

Each group was given a proposal from either the CIHR or the NIH. Proposals were chosen based on the extent to which they spoke to key concepts in the course, including those geared towards a more narrow policy orientation. More important, however, was how the proposals could directly and indirectly call to mind larger social, cultural, political, economic and environmental concerns that would shape student deliberations. Key was to tap into issues around nonhuman agency, cross-cultural engagement, environmental degradation and the politics of profit-seeking enterprises receiving public money. Again, the goal was to get students to live inside of and act out even the most theoretical aspects of the course.

From the CIHR, I chose two proposals, each tied to their “Knowledge Translation Branch,” with the second one being more directly tied to the CIHR’s recent push to promote “Two-eyed seeing” as critical to translational medicine’s future. The first was titled, “Evaluation of innovative therapeutic strategies for hemophilia A in a unique hemophilic dog colony,” and the second, “A critical ethnography examining Little Saskatchewan First Nation community members’ experiences of induced displacement.” From the NIH I chose two projects that overlapped with two other topics that had been critical to the first two weeks of the course: reproductive rights and neurodivergence. Each of these proposals was taken from a recent round of funding focused on “Translational science and specific challenges.” The first was titled “Cultural disparities in the diagnosis and treatment of autism spectrum disorders” and the second “Ex vivo female reproductive tract integration in a 3D microphysiologic system.”

Groups had one full day to review their proposals and conduct additional online research they felt supported arguments for or against funding their specific project. Students not presenting served as the jury. The decision to fund a project would be determined by the jury's votes alone, which represented a scientifically literate general public. Presenters and their attorneys would not have final say, something critical to Briggle's initial thought experiment. Though Science Court can be extended to any field of research, the focus of this exercise was on translational medicine. As a result, arguments for or against had to hinge on whether and how a particular project effectively "translates" knowledge in both socially and economically viable and beneficial ways.

Defense and Prosecution

For each project, the defense and prosecution were provided guiding questions to inform their approach to building their case. Below is an example of these questions for the group focusing on hemophilic dogs:

Defendants:

- Briefly summarize your project.
- Why does this project deserve to get funded?
- Explain how this project is 'translational'? How does it benefit the health of the population and/or the economy?
- What is hemophilia?
- Can you explain why dogs are used in this research? Are there particular benefits to using dogs to study hemophilia in humans?
- Are there limitations to comparing dogs to humans in clinical research?
- How might you respond to concerns about the ethics of purposefully breeding hemophilic dogs?

Prosecution:

- Provide a summary of the project
- Why should we not fund this research?
- Explain why this project is not adequately translational?
- Why might we want to question the value and ethics of using dogs in these studies?
- Why and in what ways does this project not adequately address questions of animal welfare and research ethics?

With these questions in hand, students were able to spread out, to the hallways, libraries and open park spaces on Princeton's campus. Christina and I floated across and between groups, fielding questions about the technical, cultural and economic dimensions of each proposal. The goal wasn't to give students a complete understanding of every facet of the proposals. Rather, it was my intention to build in them sensitivities to the unique messiness of these research projects, to not shy away from the confluence of social, cultural, political and environmental dimensions of even the most targeted, specialist fields of research.

Opening Statements and Interrogation

Each session of Science Court began with defendants summarizing their research proposal and offering insights into why the project should be funded. The goal was to make these opening statements thoughtful, compelling and concise. The prosecuting attorney then asked a series of follow-up questions. Some questions were provided in advance, to help guide student research, but students had to be prepared to answer improvised questions during the exercise as well. Remember, the jury was basing their decision on how well the two factions presented their arguments.

The prosecution was then given an opportunity to offer their own summary of the project, as well as a clear and concise overview of why the project should not be funded. The defense attorneys then asked a series of follow-up questions. These questions could be informed by statements made by the defendants during their own interrogation.

The defendants were then given an opportunity to offer counter-arguments based on the prosecution's concerns with the project. At this point, the jury was provided a chance to ask questions that might help them clarify their own understanding of the project. These questions had to emphasize the ways in which the project might positively or negatively impact society, and the extent to which taxpayer money, *their money,* was being used in both ethically and economically considerate ways. When the conversation seemed to be coming to a close, and the jury felt satisfied with their understanding of the technical, social and ethical implications of a project, the defense and prosecution would leave the room and allow final deliberations to unfold.

Winning Them Over

From the first session I used it, Science Court was a big hit with students. They were so actively engaged, and surprisingly comfortable with the messy complexities and uncertainties that drove biomedical research. With the right combination of a practical understanding of how policy gets made and research funded alongside the rich theories and case studies of STS and STS-adjacent scholarship, these students had no problem realizing that decisions had to be made even if nothing close to a complete picture could ever be drawn.

They were especially engaged with the proposals on community displacement and autism. In these proposals, students recognized that what counts as biomedical research is much broader than just targeted studies of specific disease states or microscopic dimensions of the human body. Biomedicine and biomedicalization (Clarke et al. 2010) can only be understood in terms of the social, cultural, economic and emotional conditions of everyday life. The fact that these factors would be critical to whether and how to support particular research projects helped the students see *themselves* in the proposals. They began, at least to some extent, to see themselves, whether scientific experts or not, as valuable to the decision-making process. This, I think, is worth keeping in mind as we imagine our collective biomedical futures, one where expertise is just as important as lived human experience. The experience of chronic illness for example, has so much more to do with someone's social, cultural, professional and emotional identity as it does a regimen of medications and routines imposed by a physician. The idea that these considerations could be baked into policy and funding decision processes seemed to immediately resonate with students for whom policy, and biomedicine for that matter, were often dull, siloed domains.

Performing Science Court

By the end of the first wave of Science Court in 2014, students and instructors from other courses were coming into our class to watch the proceedings. The head of the CTY program came to visit as well. All of this led to instructors asking for a toolkit for them to offer versions of Science Court in their own classes. I also presented at multiple high school pedagogy conferences with CTY program directors in the months that followed. The aesthetic and experiential qualities of Science Court, were as important as the substance of the proposals and the content of the deliberations that unfolded. In the end, my goal was to get students excited about something I knew was boring to many of them, that I knew was often presented in an entirely hollow, unfeeling way. I just wanted to build at least a sensitivity to what made translational medicine's discourses and designs equally exciting and troubling.

In the end, like many people working in translational medicine, I can't escape the combination of passion and promotion required to get things off the ground. Still, I think that Science Court represents a unique example of what STS ED reformers call "constructivist teaching" (Akcay 2007). The goal of constructivist teaching is to turn the classroom into a collaborative space for teachers and students. It is a space where the individual thoughts, concerns and beliefs of both can be, if not outright embraced, put on the table. Fulfilling these lofty and ambitious goals means turning the classroom into a space of democratic deliberation. However, even action and issue-based approaches to STS ED seem to rely on vague and unrealistic understandings of what democratic participation and deliberation can and should look like. In fact, I worry about this call for a "literate citizenry" that leaves out the institutional and financial frameworks that make scientific and medical knowledge available in the first place. An informed and engaged citizenry needs to be informed and engaged at the level of *decision-making*. Though perhaps a utopian ideal, can we not imagine a future where a scientifically "literate citizenry" can be enrolled in determining whether and how to fund projects of social, political and economic import?

CHAPTER EIGHT:

what literacy? whose literacy?

Engaged STS and deliberative ethnography point to new modes of care and collaboration, where multiple groups work together to “tolerate the unknown” and develop an “affordance for unimaginable futures” (Fortun 2012: 458). This is important because we need scientists and non-scientists alike to more creatively imagine how to shape our collective technoscientific futures. As Fortun puts it, “[t]he complexity of these conditions, the entanglements–of business and government, of law and politics, of war and farming, of natural and technical systems–is stunning, and sobering” (2012: 447). My modest contribution is to treat my classrooms as simultaneously sites of research and practice, enactments of ethnography and education, sites of theory and activism. Science Court, however imperfect, I think is at least a useful case study towards those ends.

What is Science Literacy?

Science literacy has long been championed as vital to the health and prosperity of 21st century Western democracies (Hodson 2003; Lederman 2008; Levinson 2010; Prewitt 1983). What science literacy can and should look like has been debated by governments, academics, school boards, private companies and public activists since the mid-20th century. These debates necessarily overlap with debates about what constitutes citizenship and democratic participation in highly developed technoscientific nations (Hodson 2003; Levinson 2010; Prewitt 1983). Indeed, what role should a citizen play in determining whether, how and to what extent risky and controversial scientific and technological policies and innovations play a role in their everyday lives? There is, however, a growing concern that “science literacy” has failed to live up to the goals of its proponents, and has revealed itself to be little more that a catchy slogan, a failed utopian dream (DeBoer 2000; Shamos 1995).

Concerns about science literacy have been crucial to the development of STS ED. Proponents of what can be called critical STS ED have called for a version of science literacy that trains both aspiring scientists and nonscientists alike to take responsibility for their role in technoscientific debates and decision-making procedures. However, it is rarely clear how and in what capacity scientifically literate non-scientists can or should be able to meaningfully participate. This is, in part, due to a lack of sufficient conceptual tools for thinking through concepts like “democracy”, “citizenship” and “participation” in STS ED literature. This is especially troubling now that STS ED has begun to travel to new pedagogical locations, such as Cuba, South America, and Egypt, locations where democracy looks much different than it does in Canada, the United States and England or doesn’t exist at all (Cereza 2003; Mansour 2007, 2009). As mentioned above, there also exists an unnecessary assumption that more abstract theoretical concepts are of no use to those trying to foster scientific literacy in K-12 education. Yet, as I’ve shown, incorporating social and political theories into STS-based science education can generate nuanced ways of approaching introducing students to concepts like democracy, citizenship and participation. One result might be a sensitivity to not just democracy, but the multiplicity of frameworks of governance that inform how science is taught, how research is supported and conducted and how the public might play a role in shaping the landscape of research. At the same time, we need to think about what connects the seemingly disparate groups that all champion “science literacy” as a productive goal. Governments and activist education reformers all want to promote “science literacy for all", to some extent, but the stakes and the motivations are considerably different. We might think about "science literacy" as an engaged universal (Tsing 2005), an imperfect utopian dream that generates friction between the diverse stakeholders motivated to achieve it.

Though its origins can be traced back as far as the late 19th and early 20th centuries (DeBoer 2000; Shamos 1995; Laugksch 2000), "science literacy" was first introduced in the late 1950s, and it is generally assumed that Paul Hurd was the first to coin the term in his 1958 book, *Science Literacy: Its Meaning for American Schools* (DeBoer 1991, 2000; Laugksch 2000; Roberts 1983). In describing the goals of early science literacy initiatives, some proponents have been needlessly poetic. Kenneth Prewitt, for instance, suggested that science literacy was initially meant to help the general public appreciate the "complexity, beauty, order, and ever-deepening mystery of the natural world as revealed through science" (Prewitt 1983: 49). In reality, the goals seem to be much more in-tune with concerns about national identity and American research and development supremacy. The concept, from the very beginning, was directly tied to questions about democracy, citizenship, nationalism and general education. As Rudiger C. Laugksch has argued, "[t]he impetus for interest in scientific literacy during the late 1950s is likely to have been the concern of the American science community about public support for science in order to respond to the Soviet launch of Sputnik" (2000: 72). The first way to generate this support seemed to be getting the public to recognize that, as science and technology became increasingly embedded in daily life, everyone would need to be trained to appreciate and understand, at least in some general sense, how they worked. This was the only way to ensure that people were able to make adequate judgments about everything from healthy eating choices to appropriate recycling methods (Prewitt 1983; Shen 1975). At the same time, there was a concern with how to properly train a skilled workforce that could help keep the United States at the top of the global economic and R&D food chain (DeBoer 2000).

By the 1970s, concerns about science illiteracy deepened, both for critics and proponents of large-scale technoscientific innovation. There was an increased tension surrounding the diminishing economic and industrial leadership of the United States (Bloch 1986; Laugksch 2000; Lewis 1982; Prewitt 1983; Shamos 1995). This was partially due to the economic and technological rise of countries like Japan and South Korea. The increased competitiveness of technoscientific innovation at a global scale changed the narrative of science literacy. Not only was it important to the mundane daily lives of the general public, but it was also crucial to the rejuvenation of America's science and technology R&D, perceived to be two crucial pieces to the puzzle of economic domination. Writing in the 1980s, Prewitt argues that the "major issue in the current clamor over scientific illiteracy is about the technical skill-level of U.S. workers, or more broadly, about the decline of the United States in the world political economy" (1983: 49). For many, the only way to regain the public's trust in science and technology was to help them better understand their basic scientific and technological principles. Science literacy can, as a result, be directly tied to the emergence of so-called risk society in the mid-20th century (Beck 1992).

There was thus a renewed effort to rejuvenate the pool of technoscientific labourers while also increasing the support of the general public for technoscientific innovations and policies. This was, from the outset, determined to be only possible if major science education reforms were put in place. As George DeBoer suggests, reforming science education was the very impetus for coining the term “science literacy” in the first place:

> Explosive developments in technology and concerns about national security that arose following World War II were compelling enough to command a new approach to science education. The goals of science teaching for general education purposes within this new environment came to be called scientific literacy (2000: 586).

Yet, how this general education was supposed to look differs depending on who you talk to. Broadly speaking there are two schools of thought regarding the goal of science literacy initiatives. On the one hand, government bodies tend to emphasize a brand of science literacy founded on the troubling notion of the “deficit” model of the public understanding of science (PUS). On the other hand, a number of self-proclaimed radical revolutionary STS ED reformers have championed the fostering of a “critical science literacy” founded first and foremost on the principles of deliberation and social responsibility.[49]

STS ED reformers have no interest in derailing attempts to get the general public to understand scientific principles and their impact on daily life. However, the emphasis is placed less on what have been called “practical” and “civic” forms of scientific literacy

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[49] It is important to understand how “scientific literacy” is defined in particular settings. The National Academy of Sciences (NAC) National Science Education Standards (NSES) provide the following definition: “Scientific literacy means that a person can ask, find, or determine answers to questions derived from curiosity about everyday experiences. It means that a person has the ability to describe, explain, and predict natural phenomena. Scientific literacy entails being able to read with understanding articles about science in the popular press and to engage in social conversation about the validity of the conclusions. Scientific literacy implies that a person can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed. A literate citizen should be able to evaluate the quality of scientific information on the basis of its source and the methods used to generate it. Scientific literacy also implies the capacity to pose and evaluate arguments based on evidence and to apply conclusions from such arguments appropriately” (1996: 22). The emphasis laid out in the NSES in on teaching students, regardless of their scientific ambitions, how to read, evaluate and question both academic and popular sources of scientific knowledge as well as everyday encounters with scientific phenomena. Similarly, the Pan-Canadian Protocol for Collaboration on School Curriculum (PCPCSC) also emphasizes inquiry, problem-solving and decision-making abilities in their definition of scientific literacy:“Scientific literacy is an evolving combination of the science-related attitudes, skills, and knowledge. Students need to develop inquiry, problem-solving, and decision-making abilities, to become lifelong learners, and to maintain a sense of wonder about the world around them....Diverse learning experiences based on the [PCPCSC] framework will provide students with many opportunites to explore, analyze, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment that will affect their personal lives, careers, and their future” (1997: 4).

In each of these instances, scientific literacy facilitates a recognition that we interact with science and technology on a daily basis. At the same time, there is some emphasis on the need for everyone to be able to evaluate and possibly even predict how new technoscientific innovations will positively or negatively impact their future.

(Shen 1975). Instead, STS ED champions a form of scientific literacy that emphasizes "social responsibility" at the level of every individual citizen as the first and most important goal. Social responsibility has always been an important part of, what Leonard J. Waks (1992) called, "genuine" STS. For Waks, the need for social responsibility to take precedence above and beyond all other goals was the result of an increased recognition that society was being thrust into an increasingly risky technological future. Citing Hans Jonas, Waks put it this way:

From the beginning of the STS ED movement, ethical and values concerns, and particularly:

> [t]he notion of responsibility, have played an important role. As the philosopher Hans Jonas has noted, contemporary technology has irreversibly altered the nature of human action with the magnitude of its works and their impact on humanity's global future. In the new situation, our inherited ethical and value ideas, geared to the direct, face-to-face dealings of one person and another within narrow limits of space, time, and power, are no longer adequate. This leaves us unprepared to think through our contemporary problems and options, and form convictions and make commitments appropriate for our time (1992: 13-4).

For Waks and many other STS ED reformers, scientific literacy cannot simply be fostered and then left alone. It must be guided by the efforts of every individual to recognize their own agency in shaping how and to what extent science and technology should benefit or harm the planet. The emphasis is not on simply following a set of guidelines or rules, but rather the development of a sense of responsibility that is activated individually. For Waks:

> …a person becomes responsible not merely by complying with rules, or even by expanding awareness, but also by consciously accepting responsibility, growing into it, shouldering it. Responsibility, in its most important sense, consists as much in choosing and shaping rules of conduct as in following them" (1992: 14).

Arguments like this make it clear why some might want to distinguish between academic and activistic STS. Indeed, these reformers want nothing short of a revolution in national policies that shape science curricula worldwide, a point to which I will return later.

Significantly, and refreshingly, STS ED activists assume that responsibility is something that needs to be developed over time. It is not assumed that any of us grow up knowing *how* to be socially responsible. For these self-proclaimed revolutionaries, responsibility is not an inevitable feature of becoming a citizen. However, it is the only way for citizens to truly involve themselves in shaping the worlds and worldviews in which and through which they live. As Waks puts it:

> STS ED situates the learner as a responsible agent, a young citizen, in a society: increasingly dominated by the impacts of science and technology. Responsible citizens take responsibility for the impacts of science and technology on society. They (a) seek to *understand* how changing science and technology are affecting people in our society for good or ill, (b) actively think about and decide what is right and best for society, and (c) make a commitment to participate actively, both as individuals making personal decisions and as members of society bringing their values to bear on a collective decision making, to make a positive difference (1992: 15).

So, in Waks' understanding of "genuine" STS ED the goal needs to be both "the personalization of learning and the politicization of science education" (Pedretti and Hodson 1995). So, rather than a merely practical or civic literacy, a science education founded on concerns about social responsibility and individual political agency is necessarily a "critical" form of scientific and technological literacy (Pedretti & Hodson 1995).

However, one still needs to question what, exactly, we are asking students to be critical of. In more recent years, there has been a push to develop what is called an "issues" or "action" based approach to STS ED, where students focus on the challenges and controversies *surrounding* a particular scientific or technological controversy. In my mind, a missing piece is developing in students a deep appreciation of the institutional and policy contexts that might help them understand more richly how science and technology get made. In fact, what I call "institutional literacy" might be worth fostering *before* the kinds of science literacy described above.

Between the Abstract and the Concrete: STS and STS ED

Part of my intervention involves trying to overcome unnecessary distinctions between abstract theory and concrete practice and activism that continues to pervade STS ED. This is not true of all STS ED, but the literature offers plenty of examples of curriculum designers and reformers dismissing what they call "high church" theory as irrelevant to the fostering of technoscientific literacy. Indeed, it has been assumed that since the very beginning, the divide between academic and activist STS was built into the very design and structure of North American STS programs. As Glen S. Aikenhead puts it:

> University STS programs in the USA had been formally initiated in 1969 at Cornell University and Pennsylvania State University....Their central focus was 'the analysis and explication of science and technology as complex "social constructs" entailing cultural, political, economic, and general theoretical questions' [Cutliffe, 1996, p. 291]. This content is generally more abstract than the STS content applicable to school science (2003: 3)

For at least three decades there has been a perceived need to draw lines between the goals and ambitions of two broad frameworks for STS teaching, training, research and activism. These frameworks have been awkwardly referred to as "high" and "low church"

STS.[50] As the analogy, taken from party divisions in the Church of England, especially in the 18th and 19th centuries, suggests, high church STS is assumed to be a field designed to indoctrinate scholars in a particular set of research rituals informed by an agreed upon canon of published knowledge (Cerezo and Verdadero 2003; Fuller 1992, 1999). Low church STS is, by comparison, a loosely organized social movement embraced by a number of activists, education reformers, government officials and practicing scientists. Some have assumed that distinguishing between high and low church STS is necessary due to the overly abstract theoretical focus of the former and the practical, activistic and "revolutionary" (Aikenhead 2003; Waks & Prakash 1985; Waks 1992) spirit of the latter. At the same time, in the aftermath of the Science Wars, "low church" STS can claim to be separate from and perhaps above the critique of unfettered postmodernism. [51]

Though this distinction continues to hold sway in some circles, I contend that it is unhelpful. With this in mind, I want to situate Science Court as a critical example of how academic STS can be productively and explicitly included in STS ED curriculum reforms. More than anything, I am confused by a distinction between abstract and concrete STS content, and do not understand why abstract content is generally

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[50] The division between high and low church STS was first made by Steve Fuller (1992) as a response to the so-called Science Wars. Though a brief and oversimplified account, the Science Wars pitted practicing scientists against postmodern theorists and social scientists working to unveil the social, cultural and political dimensions of scientific practice and knowledge production (Atkinson-Grosjean 1998). At the time, Fuller was distinguishing between the academic discipline of "Science and Technology Studies" (high church) and the social movement known as "Science, Technology and Society" (low church). Fuller's distinction between high church and low church STS was meant to separate the research ambitions and practices of academic "STSers" from the activist impulses of, among others, science educators and even scientists themselves. As Fuller puts it: "In response, I drew a distinction between "High Church" and "Low Church" STS, with the High Churchers following the line of the Edinburgh School in cultivating the disciplinary identity of STS, whereas Low Churchers conceptualized STS primarily as a social movement designed to transform the relationship of scientific work to the rest of society" (1999: 7).

[51] In the Science Wars, the separation served to emphasize perceived problems with overly theoretical and dubious claims of high church STS scholars. As Harry Collins noted, a major problem stemmed from the perceived lack of empirical evidence in STS research, particularly research associated with actor-network theory. These practitioners were charged with an overly relativistic view of scientific practices and products. For Collins, relativism became synonymous with "anti-science." This perspective was most vividly captured by the "Sokal Hoax" of 1996. Alan Sokal published an article, titled "Transgressing the boundaries: toward a transformative hermeneutics of quantum gravity" for a special issue of *Social Text*. As Sokal revealed in *Lingua Franca* upon the essay's publication, the whole thing was a hoax, the kind of article that, upon reading, any "competent physicist or mathematician (or undergraduate physics or math major) would realize that it is a spoof." The Sokal Hoax was presented as a clear indication that academic STS lacked the rigour and peer-review infrastructure to have anything to say about what science can or should be (Atkinson-Grosjean 1998). Sokal doubled down on his attack by later publishing an entire book titled, *A House Built on Sand: Exposing Postmodernist Myths About Science*.

inapplicable to science education for K-12 students. I am not alone in this concern. For some, the superficial distinction between high and low church STS has been cited as a reason why STS ED has had trouble reaching its ambitious goals for critical science literacy. Some have argued that STS ED has perhaps been ignored because it is perceived to be non-academic, a purely activist pursuit (Cutcliffe 2000; Nashon et al. 2008). For more critical proponents of STS ED reforms, a healthy balance between these two ways of approaching STS is vital. Nashon et al. describe the ways in which some teachers choose selectively as a way of "acknowledging and contradicting high and low church binaries and distinctions" (2008: 389). If the conditions of technoscience in late capitalism described throughout this dissertation are taken seriously, it seems productive to integrate the rich and ever-evolving archive of academic STS and related research to better train K-12 and undergraduate students to become *sensitive* to the stakes involved in shaping an increasingly complex and indeterminate technoscientific future.

It is worth noting the fact that both STS and STS ED are founded on identical theoretical concepts. Constructivism, situatedness, partiality, local vs. global concerns. STS ED is just as interested in these theoretical moves as their STS colleagues working out of graduate programs at liberal arts institutions around the world. The problem is that STS ED promotes these concepts as tools for teachers-in-training, not students themselves. These theories are described in terms of how they can best help teachers cultivate an open and collaborative classroom experience. This is obviously admirable and points to some of the unfortunate consequences of STS ED's failure to build on its momentum during the 1960s-1980s. However, it has never been clear to me why STS theories are not considered relevant fodder for K-12 education. Critical STS ED is committed to getting students to think in very nuanced terms about how *scientific* theories can and should be taught. So, why does STS ED itself need to be theory free? Why is it necessary to distinguish between the concrete and the abstract in an era where scientists themselves are embracing the rhetoric of personalization and indeterminacy? If the continued relevance of translation as a category of research is any indication, scientists are very much aware of, and hoping to take advantage of, the capital-intensive nature of biomedical research and the bizarre scale-making practices that make their work possible. It seems to suggest that we need new ways of approaching the training of future scientists and nonscientists alike, and that needs to begin at a very early age. All of these people will have to face the consequences of risky research endeavours, whether or not they are conducting the research themselves.

Theories from STS, feminist philosophy, anthropology and sociology can and should be used in K-12 and undergraduate education. How else will students be able to make sense of this complex combination of concerns: a) tensions between local and global scales in large biomedical research projects; b) the increasingly complex web of public and private stakeholders that make these projects possible and, as a result; c) the indeterminacy of future entanglements of technoscience, risk, money, and mundane social reality. A sensitivity to these issues is, I argue, a prerequisite for anything we might call critical science literacy. Whether these concerns can be successfully included in increasingly standardized approaches to curriculum design is not a question this chapter is meant to answer. I simply want to take seriously what might be required if we truly were to produce scientifically literate societies around the world.

When gazed through a critical lens, science literacy is the result of a student being taught about the social aspects of scientific innovation and policies. At the same time, students are meant to recognize their own roles and responsibilities in determining how and to what extent technoscience can shape their lives and the lives of their local, regional, national and transnational companions on this planet. However, we must be careful how we approach this. If we think STS is so important then Haraway, Latour, Shapin and other Big Picture STS scholars need to be incorporated in the STS ED curriculum. The goal, however, can't be to deify these researchers as alternatives to Einstein, Newton, Franklin and so on. STS, even its most arrogant practitioners, have never wanted this sort of treatment. There has always been too much play and dynamism, too much hesitation to take a side. This is where STS scholars can and, to be fair, *have* offered a counter-myth to unfettered scientific progress. But, let's get beyond this distinction. The only way to foster a truly scientifically literate citizenry is to have them embrace the technical and intellectual skills that go into both technoscientific labour *and* STS.

CONCLUSION TO PART 3:
institutional literacy

It might be more productive to argue over what theoretical frameworks can best prepare students for the messiness not just of technoscientific labour, but of the political and economic apparatuses through which that labour must pass. I believe that developing a level of institutional literacy is a prerequisite for attaining anything approaching the kinds of scientific and technological literacy STS ED reformers think will generate a truly active and participatory democratic society. So, why not teach theory to scientists and nonscientists alike? Specifically, why not teach, in an accessible manner, the rich theoretical tools of philosophy, anthropology, history and sociology of science that might allow students, before they even worry about science and society, to question what, if any, kind of democracy they live in in the first place?

Science Court was designed as a simultaneously theoretical and practical role-playing exercise. Inspired by Adam Briggle's article, the exercise is designed first to introduce students to an array of ways of thinking about democracy, citizenship and the peer review processes through which major technoscientific projects must pass. Students are then asked to actively take a role in deciding whether and how to fund real life biomedical funding proposals. Students are introduced to theory first and foremost. Though still in what we might call a prototype stage, I think emphasizing theory before practice is useful for helping students embrace what so many "high church" STS scholars take for granted, the complexity and uncertainty of research and interactions between an array of public and private stakeholders.

My contention is that students, both scientifically and non-scientifically minded, need to be trained to ask new and better kinds of questions. I've seen firsthand the power of training students to develop a critical posture and a healthy skepticism. Sure, students get confused and frustrated, but so did I the first time I met face to face with the idea that it might be better to embrace and make productive, rather than gloss over, difference, partiality and uncertainty in the world. However, this is precisely the kind of posture that I think can and should be fostered much earlier in science education if we hope to be anything resembling a scientifically literate society. In part, this is because the institutional processes and procedures that support scientific work are so vast and confusing that it seems unfair to leave these out of the scope of science education. Students need to become sensitive to the multiple stakeholders involved in biomedical research.

By “institutional literacy” I am referring to a particular sensitivity to political and market forces that compete and collaborate for money, minds and research environments. This is especially important in the context of translational medicine, where public and private stakeholders rub uneasily against one another in their attempts to benefit both society and the economy. In order to generate more thoughtful and socially responsible biomedical futures, students need to become attuned to these factors.

Institutional literacy adheres to STS ED’s context-dependency. Suggesting that institutional literacy is important implies that we cannot defer to vague and overly broad conceptions of democracy, citizenship and deliberation. STS research has spent a considerable amount of time reminding us to embrace a multiplicity of democratic and non-democratic frameworks of governance, capitalisms (Rajan 2006), bodies (Mol 2002; Haraway 1991), etc. As Bruno Latour argues in his powerful response to 9/11, “War of the Worlds: What About Peace?”:

> If there is one institution that has to be carefully constructed, one which is even more fragile than the ecosystems of a coral reef, it is the practice of democracy. It is one thing to request everywhere that citizens should assemble in democratic agoras; it is another to recognize that for the largest part of humanity and the longest part of history, other types of assemblages have been sought, arrangements in which humans were only tiny participants (2002: 49)

Science Court is but a modest intervention, an attempt to take seriously the notion that democracy needs to be carefully constructed in every context in which it is deemed appropriate. In some small way, my goal is to remain mindful of the dangers of using language that harkens back to "the world of Science, of Technology, of the Market, Democracy, Humanity, Human Rights" (Latour 2002: 9). STS–including its relatives from philosophy, history, anthropology, post-colonial theory, feminist and queer theory, animal studies, and so many other fields and subfields–offers many tools that can both expand and exist alongside STS ED. Many of these tools can help us instill in our students a richer and more nuanced understanding of democracy, citizenship and participation. In many ways, these nuances might be more useful to students *before* they begin learning about the theoretical and technical components of particular scientific disciplines.

Science Court is designed to provide students with a complex and realistic understanding of the peer review process. Students get to play the role of active social agents in the making, remaking and unmaking of the world they live in. Again, these are major goals of the STS ED movement. Students dive, with just a little preliminary research and discussion, into one example of a decision-making process that, in the real world, might potentially benefit or harm society and the economy in very significant ways. In this case, the roles they play are of three varieties: 1) scientific experts; 2) supplementary experts, from STS and related disciplines, who are asked, because of a particular sensitivity to asking questions of social, cultural and political import; 3) everyday people, living everyday experiences. The exercise questions whether and to what extent the general public might be able to have a say in key policy decisions related to major scientific, technological and medical innovations. The guiding questions have both theoretical and practical implications: what kind of democracy should we be living in?

There have been numerous studies that highlight the much more complex relations between theory and activism, studies that contribute new ways of thinking about how science, democracy, activism and citizenship overlap in complex formations (Epstein 1998; Jasanoff 2005; Latour 1999). This includes rich feminist-inspired theories of "world-" and "context-" making (Haraway 1991, 1997, 1999; Asdal and Moser 2012) that highlight the importance of interactions between STS scholars, educators, politicians, scientists and the general public. As Sismondo puts it, "[p]art of the work of successful technoscience, then, is the construction not only of facts and artifacts but also of the societies that accept, use, and validate them" (2008: 17). In Sismondo's framing, engaged STS simply refers to new research sites and postures. As he argues:

> The engaged program studies science and technology when they are or should be engaged, and as a result, interactions among science, technology, politics, and public interests have become topics for STS and not just contexts of study. Politics has become a site of study rather than a mode of analysis (Sismondo 2008: 21).

But interactions between technoscience, politics and public interests can and should be more than just a topic of research. As Steve Epstein (1996) and Kim Fortun (2001) have shown, ethnographers can simultaneously be activists, fully immersed in the trials, tribulations and controversies that an older breed of STS researchers studied from a distance. It is not simply a move out of the laboratory and into epistemic places (Garforth & Stockelova 2012). Engaged STS should be informed by a spirit of active involvement, embeddedness and deliberation (Fortun 2012; Hackett & Rhoten 2012).

conclusion: ENGAGED STS AND *DOING* TRANSLATIONAL MEDICINE

It is 7:47pm on a Monday in early September 2021. Despite my pandemic commute being a mere ten steps from couch to office chair, I am late for a meeting. In a few moments I will be presenting the culmination of three years of research and strategic design planning for Health Access St. James Town's (HASJT) leadership committee. HASJT is a pioneering network of service organizations in Toronto, providing community health and social services to North America's densest, most culturally diverse and economically stratified neighbourhood (Formanowicz 2022; Nguyen 2014). Co-chaired by Sherbourne Health and The Neighbourhood Organization (TNO), the HASJT is composed of over 15 healthcare organizations. Since coming together in 2013, HASJT's biggest challenge is adapting service offerings and making them accessible to new immigrant, refugee and Indigenous residents. With a focus on community health, HASJT emphasizes a holistic and, they hope, culturally sensitive understanding of health, wellness and social welfare. They want to find new ways to bring their network of service providers together as partners in order to fully appreciate the cultural, spiritual, psychological *and* physiological dimensions of community health. Navigating the layers of cultural and biomedical translation at play is tricky, which I think is why and how I came to serve as one of the network's research and design strategy consultant.

Before HASJT launched its model of service delivery in 2013 and 2014, a group of residents and service providers decided to speed up their long simmering plans to open a community health, social service and recreation hub on the main floor of a building that had been the site of a tragic fire in 2010. The fire would have been tragic enough, but service providers began to uncover a much broader and longer term crisis facing displaced residents desperate to find temporary shelter and food access. The goal was to, as quickly as possible, have a centralized location for people to access healthcare, social service and addiction support, as well as administrative aid for newcomers, and recreational programming for seniors and children. This grassroots network of residents and service providers officially cut the ribbon on The St. James Town Community Corner (The Corner) in the spring of 2011. Since 2013, The Corner has been described as the "hardware," while the HASJT serves as the "software" for overcoming the unmet health needs of St. James Town residents.

My work in St. James Town has been my greatest passion since fumbling into the weird world of experience design and strategy. I initially worked with The Corner as lead researcher for the doomed Sidewalk Labs smart city project in 2018. Working at Idea Couture, an experience design consultancy, at the time, my team was charged with helping design a community health hub that would be the centrepiece of the Quayside development on Toronto's waterfront (Robinson & Coutts 2019). I convinced Sidewalk Labs to let me do three months of research with neighbouring communities, some of the most culturally diverse, politically engaged and socio-economically stratified in the city. In my mind, Regent Park, Moss Park, Cabbagetown and St. James Town were four of the most critical, in part because of their rich histories building scrappy, flexible and adaptive models of community health and social service delivery (Rowe & Dunn 2015).

As part of this research I spent time in community hub facilities, in clinical spaces and, most importantly, in resident homes. Through a combination of immersive ethnography and in-depth interviews, I tried to get a sense of the good, bad and otherwise when it comes to providing health and social services to Toronto's most complex communities. A huge part of this involved hanging out with residents, volunteers, executives and service providers at The Corner.

One of the founders of The Corner seemed particularly interested in engaging me in long conversations about his hopes and scalar ambitions for The Corner and HASJT's future. So much so that, months after the Sidewalk Labs project wrapped, they reached out via email to ask if I would like to "do some work on the side, with us…not your company…just you." His goal was to overcome a question that had been frustrating him since I first visited The Corner months prior: "why do only companies like Google get to benefit from your work? We might not look like much, but we want to challenge our design thinking as much if not more than a tech giant. Why do we have to be 'studied' rather than produce the studies?" He was right, and I've endeavoured to give The Corner work on par with anything I've produced for big name clients at the design agencies I've worked with, with one added bonus. I get to actually be part of the process of converting my research into strategic, hopefully meaningful and sustainable, solutions.

Coming full circle to where this dissertation began, with The Corner I can honestly say that I am working in and *doing* translational medicine, in a way that feels far removed from linear models of innovation and deficit models of scientific literacy.[52]

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[52] My work for The Corner produced two reports, one for The Corner overall and one for their new The Corner@240 space, a facility focused on local sustainability initiatives like repair cafes, sewing workshops and tool libraries. Again combining time in resident homes with immersions in The Corner's clinical and recreation spaces, my reports produced a series of insights and strategic design principles to help them realize their growth ambitions. My central argument was relatively straightforward. As noted in my initial report: "The Corner is as much a philosophy as it is a unique set of shared health, social service and community programming spaces in Toronto's St. James Town neighbourhood. At the core of this philosophy is a dedication to the idea that The Corner is owned by no one and everyone all at once. The Corner presents a unique commitment to the constantly shifting needs, experiences and expectations of the people who live, work and play in one of Toronto's most diverse, densely populated and underserved communities. As of the publication of this report, the population of St. James Town stands at more than 20,000 residents, a population that spans every bracket of age, cultural and religious background, and socioeconomic standing. Due to its dense population, large number of high rise buildings and relative lack of public green spaces, St. James Town presents a unique combination of challenges for those dedicated to health, social welfare, newcomer integration and environmental activism. The Corner currently has two dedicated sites, the original The Corner@200 and the newly opened Corner@240, to meet these challenges. Corner@200 is dedicated to health, social services and recreational programs for people of all ages and cultural backgrounds. The new site, The Corner@240, focuses on issues of local sustainability and environmental responsibility. Across these sites a range of agencies, residents and local partners run programs that challenge what it means to build urban communities from the ground up. The Corner provides a vital point for residents to gain access to services and opportunities. However, The Corner is much more than a physical point of service. That is what this report is about: the always changing challenges, opportunities and areas of improvement necessary to develop a model of community-building that can keep up with the neverending flux of 21st century urban life (Murray 2020: 3)". The Corner is distinct from other community health and social service hubs in Canada. There

The multiple translations at play are linguistic, cultural, economic, technological, informatic, spatial and, yes, biomedical. But, more importantly, and however imperfectly, with The Corner it feels like I am able to actively bring diverse publics to the decision-making table.

More than paying lip service to resident involvement, every step of program and service development has been driven by a need to better understand and solve for local needs and experiences, and a recognition that these evolve fairly rapidly as new residents, businesses, and infrastructures change the identity of St. James Town. What distinguishes The Corner from other community hub initiatives I've encountered is that, from the very beginning, it has embraced the messiness of its core mission. The Corner does not shy away from the complexity of ever-shifting needs and experiences and has intentionally baked indeterminacy into its model of health and social service and program delivery. This model is inherently flexible, driven by a humble appreciation that community health hubs necessarily exist on unstable foundations. This is especially true for St. James Town, one of the most diverse and hard to pin down neighbourhoods in Canada (Formanowicz 2022). With an always fluctuating population, St. James Town

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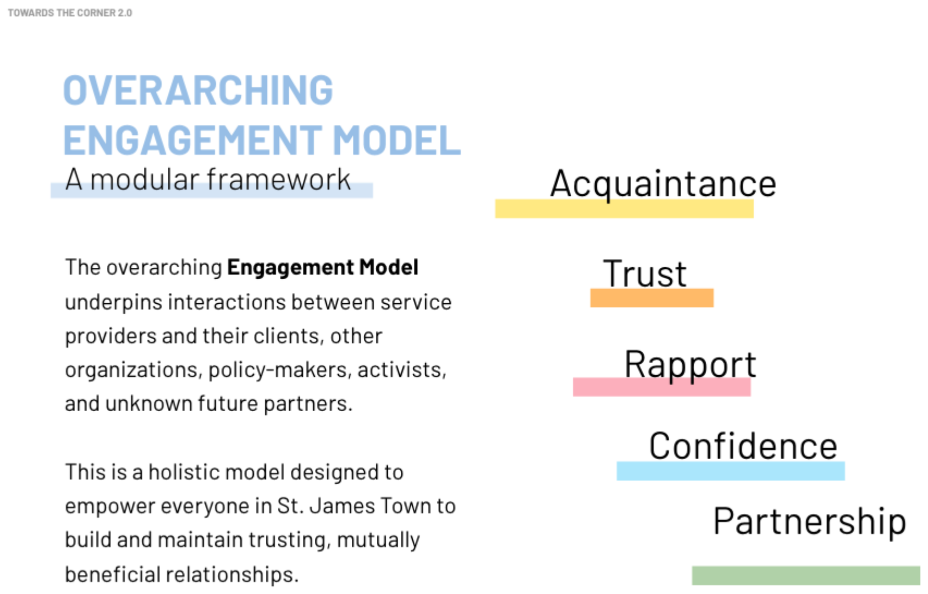
is often a serious disconnect that emerges when community hubs are in their infancy. Those spearheading a new center of community health, recreation and/or social services struggle to balance their assumptions, ambitions and areas of expertise with the needs and lived experiences of local residents and service providers. Since 2015, Ontario's strategic community hub framework and action plan has emphasized the importance of local, resident-driven needs and services ("Community Hubs in Ontario": 7). Despite this, hubs tend to be built from the top-down (Dinardi 2019; Greig 2018). In many cases, predetermined programs and services are imposed onto a particular neighbourhood and housed in a central location. This single location becomes the "hub," and resident feedback is provided around a narrow selection of services, programs and outreach initiatives. These hubs are built on a model that privileges high-level categories of health, social welfare, financial and recreational needs and service areas. There is an underlying hesitation to embrace the complexity of addressing the nuanced needs of a specific neighbourhood, and having multiple voices and perspectives shape where, how, and under what conditions new programs, spaces and services should be provided. The Corner emerged from a much different set of motivations. When it opened its doors, The Corner was the result of five years of on-the-ground work between local residents, service providers and both public and private funding sources. The Corner initially emerged when residents and service providers saw an opportunity to take over space at the base of 200 Wellesley St. E., a residential building operated by Toronto Community Housing (TCH). The space had previously served as a community health clinic run by Wellesley Hospital and then merged with St. Michael's Hospital. Residents and service providers wanted to take advantage of existing facilities, including spaces for private consultations with medical, mental health, and social service providers. At the same time, they were inspired by the blank canvases provided by 200 Wellesley's larger, open rooms. With TCH's support, a steering committee was established, one that from the very beginning was driven by the unique needs of St. James Town's residents and service providers. The governance structure that emerged provides proof of The Corner's early and ongoing bottom-up bona fides. A steering committee of 13 members oversees The Corner's operations, and consists of: 8 community residents, including both TCH tenants and residents from the broader St. James Town Community; 5 representatives from agencies that deliver services within St. James Town.

constantly reveals new and unexpected social, economic, and cross-cultural needs and challenges, especially in the context of healthcare.

The management of The Corner is a collaborative undertaking between its two anchor organizations. The operations team comprises The Corner staff as well as staff from partner organizations, many of whom are local residents themselves. This removes organizational hegemony and monopoly and places *partnership* at the crux of The Corner's operations. Residents and service providers lean into disagreements and diverse perspectives before making decisions about how to proceed with new programs, spaces and services. This is a model built on the idea that The Corner is owned "by everyone and no one" in St. James Town. Is it perfect? Of course not, but it's a step in the right direction, and points towards what I had hoped was meant by "translational medicine" when I first encountered it 12 years ago.

Translating Into Something "Real"

After completing my research, Ravi asked me to start working on answering the most important next question: "so what?" He wanted me to try and turn our research into a digestible model for bringing together HASJT service providers. What emerged was something experience designers call an Engagement Model. The one I designed for The Corner and the HASJT was adapted from a huge project I did with a chain of pharmacies who were launching a new patient support platform in the United States a year prior. This, I thought, was a much more fruitful context for showcasing what an Engagement Model could do, as a unique design tool for translational medicine. My Engagement Model was a model of partnership building between individuals *and* organizations across St. James Town.



TOWARDS THE CORNER 2.0

OVERARCHING ENGAGEMENT MODEL

A modular framework

The overarching **Engagement Model** underpins interactions between service providers and their clients, other organizations, policy-makers, activists, and unknown future partners.

This is a holistic model designed to empower everyone in St. James Town to build and maintain trusting, mutually beneficial relationships.

Acquaintance

Trust

Rapport

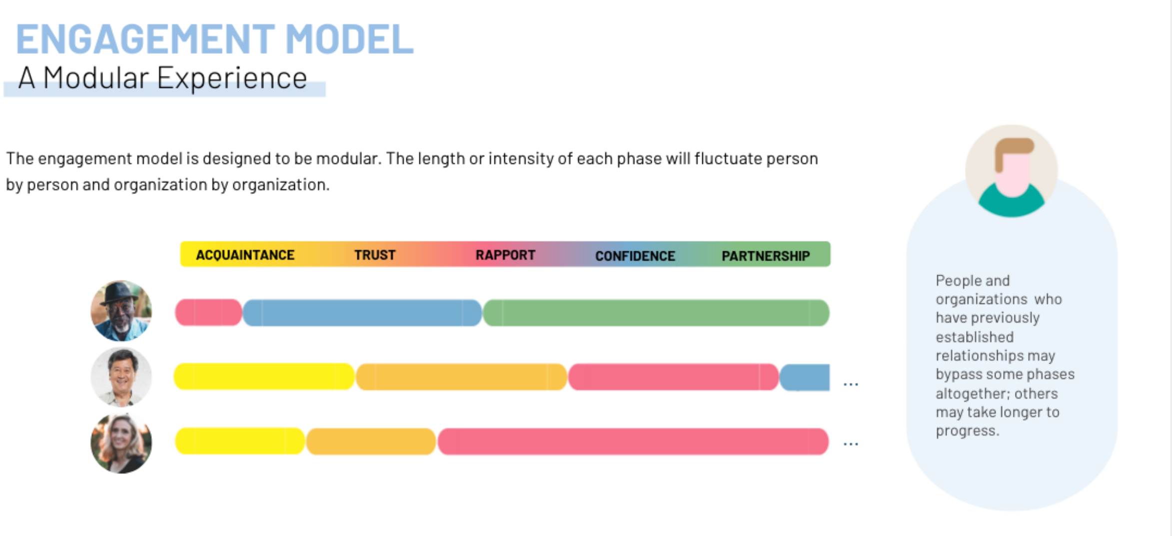
Confidence

Partnership

Figure 43: “Overarching Engagement Model”. Presentation Prepared by Author.

My model was meant to be equally useful for evaluating interactions between doctors and patients, social workers and clients, staff and volunteers at specific service organizations *and* collaborations across and between multiple service organizations in St. James Town. It was a tool for tracing scalar ambitions at individual and institutional levels.

Emphasizing the critical threads of this dissertation, I was committed to the multi-directional, multi-scalar, and *deliberative* dynamics of translational medicine in building my model. The Engagement Model was explicitly designed as a *translational* tool, one that could cut across the cultural, medical and socioeconomic disconnects that make serving St. James Town so challenging (Bisaillon, Hassan & Hassan 2017; Formanowicz 2022). Most importantly, the Engagement Model was built on modular design principles, reflecting the always indeterminate futures of a dense 21st century urban community (Clark, Smith & Vidler 2006; Goddard 2014).



ENGAGEMENT MODEL

A Modular Experience

The engagement model is designed to be modular. The length or intensity of each phase will fluctuate person by person and organization by organization.

People and organizations who have previously established relationships may bypass some phases altogether; others may take longer to progress.

Figure 44: "A Modular Experience." Presentation Prepared by Author.

The Engagement Model is meant to emphasize a values-based model of partnership, rather than a transactional one (Berkowitz, Baggett & Edwards 2019). This was key to my hopes of building a translational research culture in St. James Town far removed from an overemphasis on commercialization and hollow nods to discourses of innovation.

I do not wish to overstate the impact of this Engagement Model. I am only now in the midst of workshopping it with organizations that make up the HASJT. The model's success and overall usefulness is still very much in the air. I simply want to emphasize the importance of *doing* something about what frustrated me so much in my work as an interdisciplinary ethnographer of science and medicine trying to grapple with what exactly people meant by "translational medicine". Rather than a representative study of translational medicine, I see this dissertation's contribution to be one of methodological creativity. STS is a field uniquely suited to not just describing and critiquing, but actively intervening, into the spaces and places of technoscience. This is especially true in the amorphous contexts of translational medicine, where a concept central to STS's own theories and methods is driving a wide range of biomedical innovations around the world. Our ability to bring multiple worlds and voices together and our deep commitment to questioning what technoscientists say they do, and what they actually do, begs for STS scholars to become more active, or activistic, in their research practices. For this project, "translation" served a dual role as object and method, so much so that I can honestly say that, in the end, my method is my argument. I don't know that I have a final word to say on translational medicine, but I hope I've at least highlighted the value of dusting off old debates around translation in STS in order to better address and interrogate how the same concept and set of practices is being used in biomedical innovation.

Work It

As we've moved from the often hollow ways in which translation and design were deployed in Parts 1 and 2 to my attempt at doing and teaching translational medicine at Princeton, my goal has been to emphasize the importance of enacting our own contexts for change (Asdal & Moser 2012). As Kim Fortun (2012) has argued, description and critique no longer cut it as the end goals of ethnography in late capitalism. The missing publics tracked earlier in this dissertation have given way to my more intimate involvement in their lives in St. James Town, as much as I can muster from my privileged, and limited, position. My goal of simultaneously *staying with the trouble* and imagining how things *could be otherwise* remains intact. Still, my work with The

Corner and the HASJT, like that of Duncan and Chris in Saint John described in Part 1, is not par for the course in translational medicine.

In this dissertation, translational medicine has been recognized as a complex material-semiotic device for exploring possible, though not predetermined, biomedical futures. As anthropologist Carrie Friese has suggested, translational medicine's feasibility is "linked with its potentiality" (2013: 129). Friese's claim connotes an Aristotelian portrayal of the relationship between potentiality (what could happen), translated from the Greek word *dunamis*, and actuality (what *is* happening). Yet, Aristotle himself recognized a further division between weak and strong forms of potentiality. Weak potentiality refers to a rudimentary sense of something that may or may not come to pass in the future. Strong potentiality on the other hand engages with the political and ethical dynamics of how something could be done well, better or properly (Witt 2003). By exploring its discourses, designs and pedagogies, this dissertation has articulated what is happening in specific contexts of translational medicine (in Saint John and San Francisco) *and* points towards where it can and should be headed. All of this leads to a strong case for how I think translational medicine might be reimagined to better fulfill its *ambitious* and *ambiguous* goal of balancing the social and economic outcomes of biomedical innovations and collaborations (Rajan & Leonelli 2013).

Truly translational medicine requires translation across multiple bodies, new technologies, policy contexts, designed environments, languages, and disciplinary perspectives, not to mention public and private interests (Hostiuc et al. 2016; Rajan & Leonelli 2013; Zerhouni 2004). It is thus productive to think in terms of what I've called the *multi-translationality* of translational medicine. Each of the stakeholder groups implicated (directly and indirectly) in translational research initiatives have their own interests, hopes, and expected outcomes. At the same time, each of these groups has their own way(s) of understanding what translation is and how it should be done in specific settings.

It is within these increasingly unruly dynamics of ethics, commerce and cosmopolitics (Stengers 1997) that researchers at large-scale translational research facilities such as UCSF's CTSI, and smaller but no less ambitious sites like the research lab and medical school at DMNB, operate. It should come as no surprise that balancing the interests of local communities, corporations, government funding agencies, aspiring doctors and individual patients is both a *necessary* and an *impossible* to fully realize goal in translational medicine. Getting close would seem to require careful and robust articulations of what exactly translation means for each research and training initiative that identifies with the label (Rajan & Leonelli 2013). It would also demand clear statements concerning how the needs and interests of non-scientist patients, loved ones and community members will be assessed and, ultimately, how they will be translated into products, practices and profits. As I've shown, however, we need to remain concerned with the ways in which publics are often reduced to a set of corporate slogans, implicated as they are in the "from bench-to-bedside" mentality of translational medicine (Rapp 2011) as *receivers* but not negotiators of care.[53]

Even as translational medicine turns its attention to community-based research and personalized medicine, it remains to be seen whether patients and publics "will

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[53] Recent sensitivities to the politics of care (Puig de la Bellacasa 2010) in STS have re-emphasized the need for attention to be placed on negotiations of the terms of care and not assuming that publics simply need to be cared *for*. Michelle Murphy (2012) makes clear that feminist modes of care have been, and continue to be, simultaneously enabling and antagonistic, entangled in complex relations that are neither purely epistemic nor inherently better. This push against romanticizing particular modes of attention reminds us that a focus on mundane, material realities is necessary if one is to cultivate a world where difference and uncertainty can be embraced and made productive. Care, like ethics, cannot be rendered into a set of universal guiding principles, but must be recognized as an always contentious event (Fortun & Fortun 2008).

direct knowledge production activities or will merely be used as data points, blood samples, or trial specimens" (Taussig & Gibbon 2013: 477). Concerns about patients serving as little more than the raw materials of translational medicine also overlap with questions of biological citizenship and to what extent anyone can be, or might feel obligated to become, a biomedical research subject (Taussig 2005, 2007; Schaefer 2009). All of this speaks to my persistent inability to answer the question that kicked off my dissertation research so long ago: "What *is* translational medicine?"

No, Really! What IS IT!?

In the end, I can't really answer this question. It is context-dependent, and contexts, I now wholly believe, are ever-evolving and negotiable, not pre-existing the moment of cross-cultural encounter (Asdal & Moser 2012). What I can say is that the lack of specificity in the definition and practice of translational medicine has not stopped it from gaining serious legitimacy in North America, Europe, as well as a number of East and South Asian contexts. Spurred in part by the NIH roadmap (van der Laan & Boenink 2015) translational medicine has gained legitimacy thanks to the publication of journals—including *Clinical and Translational Science, Journal of Translational Medicine, and Science: Translational Medicine*—the development of graduate programs, including combined programs that offer medical and Master of Business Administration (MBA) degrees, and the building of expensive "centers," dedicated to the training and housing of translational researchers as well as the dissemination of their work.[54]

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[54] The growth of translational medicine has been particularly rapid and pervasive in the United States where, since 2006 and partially the result of congress's passing of the NIH Reform Act that year, the NIH's Clinical and Translational Science Awards (CTSA) have provided funding and support for almost 60 centers of translational research (Zerhouni 2007). The stated goal of the CTSA is the fostering of a new consortium of individuals, institutions and private companies, who wish to mutually benefit each

As Anna van der Laan and Marianne Boenink have argued: “the attempt to make society benefit from its investment in biomedical science is laudable, but also quite ambitious. To realize it, many different activities, by different actors, in different settings need to be performed, to cross many different gaps” (2015: 46). van der Laan and Boenink lament the idea that all of these actors and ambitions should be labeled with one concept, translational medicine, suggesting instead that it:

> ...may be more helpful to think of such beneficial innovation processes in terms of a nexus (or web) of many translational moments: moments at which the design of present work needs to anticipate, and to be coordinated with, the requirements and characteristics of its future contexts of use” (2015: 46).

All of this points to a need for more robust considerations of how translation works or should work in biomedicine and who, ultimately, it works to benefit (Haraway 1991; Rajan & Leonelli 2013). Considering the large amounts of public and private money going into supporting translational medicine, it is also important for us to consider how biomedical translators are being trained and how we might make the public more concerned about the goals and ambitions of these researchers. Publics themselves, remember, are no less adept at translation than the experts. It is a very instinctual human activity. This last concern plays into a much larger issue surrounding how best to generate a scientifically literate society, which was addressed in Part 3.

For now, the best I can do is point out that patients, non-expert communities and advocacy groups are all directly or indirectly implicated in definitions of translational medicine, mission statements by newly designed translational research facilities, and in appeals by and to policymakers. Yet, within the discourses, designs and pedagogies of translational medicine these publics often act, as one colleague suggested after a

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other by speeding up both the commercialization of biomedical knowledge and the betterment of human health. This has culminated with the recent opening of the NIH's National Center for Advancing Translational Sciences (NCATS) in Bethesda, Maryland.

presentation of a very drafty draft of an early chapter, as "phantoms." Whether intentional or not, this colleague evoked Walter Lippmann's 1925 targeted diatribe (masked as an appeal for respect for the general populace), *The Phantom Public*, in which the journalist and social commentator argued that:

> The private citizen of today has come to feel rather like a deaf spectator in the back row, who ought to keep his mind off the mystery of there, but cannot quite manage to keep awake. He knows he is somehow affected by what is going on. Rules and regulations continually, taxes annually and wars occasionally remind him that he is being swept along by great drifts of circumstance (383).

The phantom public(s) in translational medicine are not, in my mind, publics that cannot handle the complexities of shifts in biomedical practices and policies. Rather, they have simply not been included in negotiating the disparate scalar ambitions of healthcare practitioners, private companies, research institutions and legislative bodies. They are framed, instead, as recipients and consumers of care. Researchers share and debate increasingly robust models of the "translation process" and social scientists interrogate the ethical, political and economic consequences of these models (Hostiuc et al. 2016). Yet, in publicizing the importance of translational medicine, researchers have tended to fall back on dated models and metaphors, such as the deficit model in the public understanding of science and the linear model of innovation.

One way of addressing these concerns is to take seriously the open invitation to anthropologists, economists, sociologists, and political scientists to engage in shaping the future of translational medicine, but not just in our perceived roles as experts. It might actually be our critical stance towards expertise that makes us suitable bridges between expert and non-expert communities in shaping the contours of translational medicine. In navigating the role of social science, humanities research and information sciences in translational medicine, it cannot be ignored that these fields all have a rich and complicated history of, and nuanced encounters with, translation as both an obstacle and a necessary component of research design and practice.

We Have Never Been Nonlinear

Throughout my fieldwork, I continued to walk, stroll, strut, and stumble. I wasn't exactly aimless, but I followed something akin to a Situationist's *dérive*. This was a fluid, unplanned journey across and between the discourses, designs and pedagogies of translational medicine. The process was *linear*, but not in the way we usually think of "linearity" today. In his fascinating *Lines: A Brief History,* Tim Ingold puts it this way:

> ...whether encountered as a woven thread or as a written trace, the line is still perceived as one of movement and growth. How come, then, that so many of the lines we come up against today seem so static? Why does the very mention of the word 'line' or 'linearity', for many contemporary thinkers, conjure up an image of the alleged narrow-mindedness and sterility, as well as the singletrack logic, of modern analytic thought? (2007: 2)

Growth, movement, and process do not require lives that unfold from point to point in logical, predetermined progressions. *Progress* does not need to be unidirectionally linear. Yet, there persists an assumed rigidity and orderliness to discussions of linear thinking and movement. I would counter that I have pursued my research in a linear fashion, yet I have used methods that have not been based on any orderly or rigid frameworks or hypotheses.

I am not trying to be cheeky or overly playful here. I have been thinking a lot about linearity over the course of this project. In part this is because translational medicine is intimately entangled with the history of the so-called "linear model" of innovation that has shaped how technoscience is supported and funded in North America. Though perhaps a “straw man” (Edgerton 2004; Godin and Lane 2013), the linear model has received a lot of play, and continues to inform a number of rhetorical devices employed by politicians and industry leaders hoping to obtain public and private support for co-funded innovation initiatives. Innovation, the model postulates, moves from basic to applied research, then into the development phase. This is followed by production, marketing and, one should probably add (though many do not), consumption.

Though more robust models have long existed alongside the linear model, perhaps most notably the demand-pull model (Godin and Lane 2013) in the mid-twentieth century, the linear model was dominant for decades and, as mentioned above, persists in the production of soundbite descriptions of innovation and its capacity to simultaneously benefit society and stimulate the economy.

There is also a narrowly conceived notion of linearity in the deficit model of the public understanding of science, which has been key to frameworks for building a scientifically literate citizenry for decades. This model is almost identical to the linear model of innovation in that it is often employed by government and industry leaders and seems motivated simply in the interest of fostering blind support for risky technoscience.

In each of the above cases, there is an assumption that, if placed in the right hands, technoscientific knowledge and/or innovations will move from the appropriate experts to the bodies and minds of the general public and only then be distilled into the coffers of governments and private companies. *“Translation. Just. Fucking. Happens.”*

This is perhaps the most important point for those of us interested in the peculiar “bioeconomies” (Birch and Tyfield 2013) that have emerged over the last few decades: those who use this brand of linear rhetoric, especially politicians and Silicon Valley optimists, emphasize that this unidirectional movement will invariably benefit both society and the economy. This is a slightly more polished vision of sociotechnical progress but one that can’t seem to escape Enlightenment assertions about the movement of humanity towards a perfect, utopian future, guided by an elite group of knowledge-makers and translators. Yet, people progress in many directions and at many scales, individually and collectively, along with a plethora of devices, living bodies and environments. These will never be held together in such a way that we can say we fully grasp where we’ve been, where we are or, most importantly for my purposes, where we are going in biomedicine. So, how exactly do we prepare ourselves and our fellow travelers for the messy and indeterminate biomedical future(s) on the horizon? This is, for me, as much a question about research design and method as it is a question about how to mobilize my findings.

I should make clear that few scholars would actively subscribe to the rhetoric of unidirectional linearity outlined above. This is part of the problem. The historians, philosophers, sociologists and anthropologists who have shaped contemporary STS have worked hard to discredit not just these kinds of progress narratives in industry and government, but within our own ranks as well. The shift from the troubling consequences of internalist history to the more robust, if not always successful, goals of contextualist history of science is one of the earlier, most direct and telling examples of this (Shapin 1992). In the externalist/internalist debate there emerged new ways of thinking about history that no longer needed to move from individual genius to individual genius in a long succession of unidirectional progress (Lightman 1997). At the same time, researchers were concerned with an overly externalist approach that emphasized a deterministic understanding of social, political and economic contexts in the production of scientific knowledge. Not to mention concerns that, until the 1980s, most researchers privileged the contexts in which elite scientists worked and lived, to the detriment of an understanding of how women and subaltern populations, among others, contributed to the rich fabric of scientific knowledge and labour (Russett 1989). Though there is no one approach to contextualist history of science, it is safe to say many are in agreement that there are “no insides or outsides of science” (Lightman 1997: 7). At the same time, there is no easy to trace evolutionary chain from earlier to newer scientists, which also implies that there is no way to justify claims that contemporary technoscience is cumulatively and inherently superior to past knowledge innovations. Most importantly, this implies that individuals, whether scientists or nonscientists, can and should have a role to play in shaping how new technoscientific innovations operate in the world. In critiquing certain narratives of progress, STS opens up numerous paths for activism within and without the academy.

Considering how much ink has been spilled on discrediting a particular brand of progress narrative in STS, its persistence in the realm of politics and tech innovation, and subsequent acceptance by a wide swath of the population, is both confusing and troubling. The problem stems, in part, from the fact that both academic and activist models of STS have failed to “get out” into the world. The “engaged” program of STS (Sismondo 2008) has been working to actively take responsibility for our transdiscipline’s role in shaping technoscientific futures at all levels of research, policy, pedagogy and community outreach. It is the perceived failures of both brands of STS, and a desire to more effectively integrate them, that have informed my larger goals as an interdisciplinary ethnographer of science and medicine. Especially one who now can't imagine actually working in an academic setting.

Another issue has to do with the perceived complexity and non-linearity of a number of approaches to so-called academic STS (Heath 2007; Masys 2006). Actor-network theory and a range of feminist approaches to STS have been championed for their complexity-based approach to theorizing how social worlds are made (Masys 2006; Tatnall 2013; Asdal and Moser 2012). As Gough (2009) puts it, "[c]omplexity theorising invites us to understand our physical and social worlds as open, recursive, organic, nonlinear and emergent, and to be suspicious of mechanistic models that assume linear thinking, control and predictability" (13). Yet, this distinction between linear and nonlinear thinking can make it seem as though nonlinearity is the product of unfettered openness and relativism, making it unclear how these kinds of STS approaches can be distilled into meaningful engagement with broader publics. Indeed, academic STS is often perceived to be *too* abstract and nonlinear to ever be useful in science education or discussions with the general public (Aikenhead 2003). I would argue, however, that academic STS provides a *more* realistic and dynamic picture of linearity. One might argue that "we have never been nonlinear," and that our lines must be recognized for what they are: unwieldy. As Ingold puts it:

> The world we inhabit is one of such profuse linearity that it is virtually impossible to accommodate it all within some neatly ordered system. Indeed it is in the very nature of lines that they always seem to wriggle free of any classification one might seek to impose on them, trailing loose ends in every direction. It is not hard to think of instances that do not fit the categories I have suggested (2007: 50).

Thinking of linearity in this way might help STS researchers connect both with their technoscientific interlocutors and with the broader publics in which they want to engage. In translational medicine, for instance, a number of proponents have tried to highlight the ways in which translation is not unidirectionally linear. They have produced more complex and open-ended models of translational medicine.

I am interested in a multiplicity of *linearities* and how they shape both contemporary moments and imagined futures of biomedical culture. This does not mean that I am only interested in open-ended, relativistic and incoherent scholarship. Instead, I believe that the lines we draw, trace and follow in work and life are much more difficult to reel in and render whole than some might think. Falling back on dated and ultimately false understandings of movement and progress in this world will continue to generate a troubling lack of understanding on the part of the general public about how biomedicine is done. Minimizing these misunderstandings can and should be a foundational goal for STS scholars and STS education reformers.

A Final Note on Deliberative, Anthropologically-Informed STS

Entrepreneurial models of ANT and translational medicine have not explicitly informed one another, but they do seem to stem from a similar history that can be traced back to the increased professionalization of science, as well as the emergence of "Big Science" in the twentieth century. In each instance, too much emphasis is placed on the superficial resolution of controversies, along with metaphors of war and death.

Too often scholars enter their research assuming that the agonistic model is simply how things are in science. As Emily Martin suggested in her address to the 1991 meeting of the society for the social studies of science (4S):

> Here is where anthropology can make its radical critique. What if network building and resource accumulation are not the only way knowledge is established? What if many other kinds of processes proceeding from

> fundamentally different assumptions about the world profoundly affect experts and scientists even as they accumulate resources and build networks? What if important, forceful processes flow into science as well as out of it? What if nature is not simply what natural scientists tell us it is, and what if society is not simply what sociologists tell us it is? What if instead people who call themselves scientists are continuously interacting with, and being profoundly affected by, people who do not call themselves scientists? What if, in complex historical circumstances, both scientists and nonscientists are forging ways of acting, being, and thinking in the world, or in other words, forging what anthropologists call cultures? (1991: 28).

For Martin, an anthropology of science can only be successful if practitioners develop a richer and more inclusive understanding of what counts as relevant to the production and dissemination of scientific cultures. This is especially important in a research climate where capital intensive biomedicine has been and will continue to be the norm (Martin 1991; Rajan 2006; Cooper 2008; Fortun 2012; Birch and Tyfield 2013). At the same time, the anthropology of science often embraces an understanding of culture that de-emphasizes the importance of “coherence” (AbuLughod 1991: 147). By deemphasizing coherence, anthropologists can productively rethink what is “comparative” about their work and what the stakes of comparison are going to be. Without social structures, orders or hierarchies, what is unique about an anthropologist of science? Does anthropology remain nomothetic,“of which the aim is to provide acceptable generalisations (sic)” (Radcliffe-Brown 1952: 3)? If so, what do these “generalisations” look like? What kind of comparative practices can an anthropologist of science reasonably engage in?

Increasingly, it appears that the strengths of anthropologically-informed STS lie in its ability to generate flexibility in the kinds of comparisons, generalizations and collaborations available to researchers. Anthropologically-informed STS is unique in its ability to navigate the “stunning and sobering” complexity of late industrialism

(Fortun 2012: 447). Kim Fortun has argued that anthropological approaches to ethnography, when conducted carefully and thoughtfully, produce “both situated and comparative insight” and are “able to see across scale, and leverage different analytic lenses” (2012: 447).

The stakes of my own project align nicely with Fortun’s description. I have asked, following Rajan & Leonelli (2013), not what knowledge is and how it travels, but how disparate groups, made up of scientists and nonscientists, might recognize and take responsibility for the role they can and should have in shaping the future of biomedicine. I have, I believe, chosen to study *in* the world and have leveraged multiple lenses with which and through which to explore translational medicine.

Perhaps the scope of anthropologically-informed STS projects is less about close descriptions of specific groups of people, whether “here” or “there,” and more about deliberative and provocative modes of expression. Modes of expression that recognize the complex movement across time and space that make the late industrial period so hard to trace, and make its future(s) so hard to predict. Perhaps this allows comparison to sneak back into anthropology without the need for descriptions of “universal man.” As Fortun puts it:

> What we can think or say even within the idiom of anthropology cannot but be within established systems of ideality. Thinking in terms of theory, even poetics, delimits us. So we must proceed with humility, humor, and reflexivity, reaching to move from the over-determinations of description to provocation, knowing that we will have to design something otherwise” (2012: 453).

Things change, and a truly translational approach to biomedicine would recognize that from the outset. There is no need for a unifying definition, because translation has never been about stability. Translation, especially in translational medicine, is about "mobility." Much like my approach to fieldwork, translational medicine is about multiple bodies, disciplines, languages and technologies walking and stumbling their way across and between one another. As Rajan & Leonelli put it, if mobility rather than stability and unification, is key to understanding what translational medicine could be, then it makes it all the more important to understand the ethical, political and material-semiotic dimensions of translation itself:

> Mobility is therefore central to the idea (and ideal) of knowledge that animates translational research. In order to act toward the aspiration of "improving human health", biomedical claims, objects and practices have necessarily to move across boundaries. In such movements, the question of what counts as true knowledge comes to matter only alongside a host of other concerns, such as the commensurability, exchangeability, fungibility or accountability of knowledge-making practices and their outcomes. Enabling and managing such mobility requires extensive efforts, and indeed requires us to think about that key concept embedded in the very name "translational research", which is translation (2013: 6).

Returning to the flowing river that opened this dissertation, translational medicine is all about flows both upstream and downstream, flows that can never be predetermined or reeled in along finite boundaries (Galison 1996; Starr & Griesemer 1989).

The mobility inherent in translational medicine, and translation more broadly, can only ever become more than hollow, commercial, and *trans*-actional, if we appreciate the inherently political and ethical stakes at the core of all acts of human translation. This requires a complete reorganization of the discourses, designs and pedagogies of translational medicine. Which is funny, in a way, because in the end, the path forward is really just one big design challenge.

"That's the answer then: Everything depends on design."

- Flusser, *The Shape of Thing*

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