Visualization as Assemblage:
How Modesty, Ethics, and Attachment Inform a Critical Design Practice

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Abstract

Visualization is a form of design practice that deploys representational processes of enormous rhetorical and analytical power. What is often left out of the picture is the network of processes which it assembles and the non-visual effects it produces. This study asks *how visualization can operate as a critical design practice that attends to the representational and performative processes it arranges*. In order to contextualize this form of arrangement in design, the study undertakes a review of Bruno Latour's interpretation of design as a form of modest restyling and arrangement. It also addresses this question through the use of a productive alignment between Latour's development of actor-network theory and Deleuze and Guattari's assemblage theory which allows to both describe how things and processes mobilize knowledge and how human subjectivity emerges from human-nonhuman entanglements, respectively. The assemblage framework is applied to three case studies that offer distinct instances of critical visualization practices with each emphasizing a specific aspect. *Liquid Traces* (2014–present), from Forensic Architecture (a research project based at Goldsmiths, University of London), is a project that condemns NATO forces for criminal negligence that led to the deaths of 63 refugees fleeing Libya by boat in 2011, and also reveals the ways a surface may assemble components and highlight its own form of construction. *Anti-Eviction Mapping Project* (2013–present), from the San Francisco Tenants Union, advocates for housing justice by mobilizing maps, events, and site-specific installations, and illustrates how visualization is a process that exists beyond any one artifact. *In The Air, Tonight* (2013–present), from the Public Visualization Studio, is my own "research-creation" project highlights the connection between housing and climate through an annual visualization event, and shows how design can operate through iteration, reworking, and connection to allied processes. What emerges from this study is an ethics of visualization that refocuses criticality on the potential of design to act "modestly" (Latour), to reveal its own construction, and to maintain the quality of attachments made.

Dedication

I dedicate this thesis to my partner Patricia Pastén, without whom it would have been impossible to embark on this whole journey. I also dedicate this to my daughter Aurea Elfride Dávila Pastén who always reminded me of the value of this endeavour.

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It is difficult to enumerate all the interactions, messages, and presences that contribute to the work involved in a project like this. I am grateful to the many people including family, friends, and colleagues who have indulged my obsession, and given me the space and resources to complete this work. In particular, many thanks go to my advisor Janine Marchessault who recommended that I undertake a Ph.D. in the first place and who has guided the development of my work throughout. My deep appreciation to committee member Jan Hadlaw who generously offered her knowledge and expertise, and helped me further my own understanding of critical engagements in design. My sincere thanks to committee member Caitlin Fisher who, since my Master's work, has continued to provide inspiration from her own work and guidance for mine. I also feel a deep gratitude to David McIntosh, a teacher in my undergraduate career, and now a close friend and colleague who encouraged my pursuit of this degree and continued to emotionally and intellectually support its development.

Dave Colangelo and I collaborated on numerous projects throughout my time in the Communication and Culture program. These projects and our conversations illuminated many of the ideas in this dissertation in practice. I would like to also acknowledge the role that my students have played in generously responding to the incremental implementation of concepts developed over the last five years. It is their enthusiasm for this scholarship and practice that drives me to contribute to the field.

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Chapter One: Introduction

Introduction

The goal of this project is to develop a theory of representation in contemporary design practice that acknowledges the processes of data collection, communication, and project-making as well as the objects which are part of the design process. Representation takes place on many fronts and includes processes on political, cultural, historical, technical, aesthetic, and philosophical registers. Design activity is implicated in all these fields because it brings into being a multitude of artifacts that are attempts to respond to specific issues that comprise an artificial world. By attempting to develop this notion of representation the present work also aims to contribute to the field of digital humanities through the study of design theories, visualization, and critical theories. Digital humanities, although a relatively new subfield, has often been described as an interdisciplinary practice that combines design, digital theory, critical theory, and visual techniques with humanities and social science research. Digital humanities also aligns with one of the premises of this dissertation—namely, that artificiality, as the entanglement of human and nonhuman, is a precondition for moving beyond nature/culture or science/humanities splits.

One consideration in understanding representation in design activity is the movement between a critical (or negative) and a postcritical philosophy of media and technology. Critical theory is generally characterized as finding media and technology to negatively limit human consciousness and reduce the possibilities of emancipation. Postcritical theory, on the other hand, typically highlights social practice and hegemonic/counter-hegemonic practices that make

use of media and technology. A critique of representation has been a core activity in the critical approach whereby the forms that are produced in a capitalist context are unpacked in order to understand the real meaning and dynamics behind the façade.[1] The other consideration seeks to place human agency amongst the agencies of other actants with a resulting network of agents that communicate power through numerous mediators (including objects, environments, animals, technology, etc.). This postcritical approach puts less emphasis on the veracity of representation and more on its process, deployment, negotiation, and re-interpretation. This refocusing, for instance, has been developed in geography, and science and technology studies.

This study will focus on visualization and design practice as a site of inquiry. Visualization has taken many forms in design: sketching in the very beginnings of ideation; documentation of practices, sites, and people in the research of a given phenomenon; diagrams that describe or outline a network of actants; and data representation that aids analysis and communicates specific narratives. Within design practice, visualization is therefore an immensely important and central activity that as a site of inquiry will allow for a consideration of the ways that processes, people, and things are represented. Specifically, this study will look at visualization practices that exemplify a move from a critical to postcritical approach in design practice. This investigation will involve looking at design outcomes and design practices, that are at times difficult to separate and treat in isolation, but nonetheless provisionally offer moments to think about how representation is at once a process and an object that creates possible worlds.

1 While this polemic has been mainly limited to architectural theory and practice (Somol & Whiting, 2002; Baird, 2004) it has some correlates to developments in geography and communication design. These tensions have centred on critical/postcritical issues as well as on other related dichotomies such as representational vs. post- or nonrepresentational.

A major impetus for this work was my need to develop a framework that helps designers redirect their practice to better address the major crises facing contemporary society, namely environmental degradation and growing social and economic disparity. It is designers, visual designers in particular, that can provide ways of rendering complex phenomena visible, readable, and possibly intelligible. This was the call made by Bruno Latour in his address to the Design History Society in 2008. Latour frames design as a practice of repair rather than revolution, and one that may help us better represent complex assemblages (i.e. social, political, environmental, technological) in order to make better decisions regarding these issues—visualization is one such practice.

Yet, given the legacy of denigrating visuality in western civilization (Jay, 1994) and the relatively recent incorporation of the design field into academia, visualization and design have not received sustained critical inquiry. The exceptions to this come mainly from science and technology studies (Daston & Galison, 1992; Dumit & Burri, 2008; Haraway, 1997; Jones, 1998; Latour, 1986; Lynch & Woolgar, 1990) and geography (Crampton, 2001; Pickles, 2004) with some coming from contemporary visualization (Manovich, 2002; Sack, 2007) and design (Drucker, 2014; Hall, 2011). This general lack of attention and the abundant need to embark on this kind of investigation is noted by Drucker (2014). The lack of more critical work on visualization is also exacerbated by the enduring imprint of the *two cultures* (Snow, 1993) problem in which the natural sciences and the humanities have shared an equal suspicion and disdain for the claims made by the other. Where visualization has found the majority of its funding, researchers, publications, and application is in the fields of computer science, statistics, human-computer-interaction, and cognitive science. It has therefore played into the siloing of

disciplines and specialization. As noted above, this trend shows some evidence of becoming less dominant due to the increased attention given to the digital humanities, in which a large variety of research agendas find part of their expression through interactive, generative, and often visual tools and projects that synthesize and/or represent different forms of data. Furthermore, design is one of the disciplines/practices particularly suited to working between content and expression as well as between material and symbolic interactions, and therefore finding passages of influence between these relationships. For example, working materially for a designer is a basic empirical process of discovering the properties and interactions of any given medium. Working conceptually for a designer is a basic thinking process of relating concepts. Both can be seen as creative processes in which something is devised.

Research Question

The guiding question for this study is: how can visualization operate as a critical design practice that attends to the representational and performative processes it arranges? Addressing this question entails looking at several other supporting questions. For instance, how do visualizations work as assemblages that arrange people and things? As a result of this human-nonhuman entanglement a question of how subjectivity is produced within these assemblages also emerges. Following this line of inquiry will lead to an understanding of design's role in arranging these assemblages as well as an understanding of an ethics of visualization.

Framework

The object of this study is interdisciplinary in nature and as such relies on related bodies of literature and research. The framework used in this study emerges from key overlapping concepts in actor-network theory (ANT) (Latour, 2005b; Law, 2009) and assemblage theory (DeLanda, 2006; Deleuze & Guattari, 2004). The utility of combining aspects of these two frameworks relies on how one is useful for describing specific objects that mediate and the other is useful for describing the production of subjectivity. Their overlapping and complimentary nature has been noted by Müller (2015), for instance, and similar roots and readings of precedents appear in Latour and Stengers. It is also important to note how both frameworks are deeply indebted to a French continental form of philosophy and specifically a post-structuralist ethos in which a deep respect of empirical sciences is coupled with a deeper reading in the arts and humanities. Perhaps the most important aspect of their joint use is the way both put an emphasis on systems of association that are contingent, mutating, emergent, and which express different forms of power relations. What also makes this combination useful for the work in this dissertation is that the question of representation and performativity has often been raised, albeit in different ways, in the work done by Latour and Deleuze & Guattari, who are the central figures in these frameworks.

Actor-network theory is partially a result from a turn in science and technology studies that saw social constructionism counter the dominant positivist account of scientific knowledge. Assemblage theory is partially an outcome of the disillusionment of the post-1968 leftist movement, the use of psychoanalysis in Marxist thought, and the start of an ecological analysis

of posthuman subjectivity. Both frameworks are also heavily influenced by the increasing role of ecological and cybernetic thinking. In this sense, these theories attempt to describe phenomena through the lens of flat ontologies (Bryant, 2011; DeLanda, 2005) that place agency within the realms of both human and nonhuman actants. This is part of their emphasis on the relational nature of power and the role played by nonhumans in the stabilization or disruption of, among other things, social configurations. These related frameworks are particularly well-suited to the study of design activity due to their deliberate privileging of the agency of designed objects and their attendant intentional and non-intentional effects on the social sphere as well as the role of nonhuman components on human subjectivity.

ANT, as Latour has often remarked, is not a theory so much as a methodological approach (Latour, 1999b, 2005b). It sets out an outline of methods that aim to create very modest yet accurate and comprehensive accounts of particular phenomena. For the purposes of this present study, ANT will not be used as a guide to carry out research but rather as a perspective with tenets regarding the description of agency and relational networks of actants. The ANT concepts of *immutable mobiles* (Latour, 1990) and translation (Callon, 1986) are useful tools to understand the relations of power specific to visual design, visualization, and visual communication. Where immutable mobiles are objects which circulate as stable representations of given phenomena or space and extend power over what is represented, translation is a process by which problems are articulated, allies enlisted, roles are defined, and actors are mobilized. Immutable mobiles and translation are therefore key concepts for understanding representation.

The use of these frameworks also leads to a consideration of expression (Deleuze & Guattari, 2004; Lazzarato, 2003; Massumi, 2002a; Whitehead, 1968) as a fundamental concept

with which to understand representation in design. The notion of expression emphasizes the processes by which a representation is made but also the propositional or generative character of representational practice; as Lazzarato states, “images, signs and statements do not represent something, but rather create possible worlds” (Lazzarato, 2003, para. 2). This is also key to understanding design as an expressive practice that strategically deploys visual/textual/aural objects of communication as well as tools, environments, and systems that are handled, inhabited, and embodied. This, in turn, is a generative force.

More recently, the work done under the heading of speculative realism or object-oriented ontology takes up some of the philosophical underpinnings of actor-network theory along with Deleuze’s assemblage, Whitehead’s pragmatism, and Heidegger’s phenomenology. The emphasis is placed on the status, definition, and interaction of objects—in stark contrast to thinking of phenomena through notions of meaning and difference. Object-oriented ontology expands theories of signs, discourses, and representations to include the nonhuman, objects, technology, and the natural environment (among other things) as active agents impacting humans and others (Bryant, 2011). It finds allies in the work of Delanda (2005), Haraway (1991), Suchman (2007), Barad (2007), Bennett (2010), and Latour (1993b), all of which share a logic of flat ontologies in which objects are regarded as having a reality and agency equal to that of humans, although not necessarily equal in strength.

Outline

This study is organized into five sections which proceed from a discussion of the role of design to how visualization operates and on to specific instances of visualization practice. Throughout it situates the work at the intersection of three related bodies of literature and practice: information visualization, design theory and practice, and the overlap between actor-network theory and assemblage theory. The second chapter analyzes the role and definition of design through Bruno Latour's keynote to the Design History Society. This sets the groundwork for further exploration of the relationship between design and visualization through an actor-network/assemblage theory framework. The third chapter describes the way visualization design presents information, accrues power and produces subjectivity through specific concepts developed in actor-network theory (e.g. immutable mobiles, cascade of inscriptions) and assemblage theory (e.g. enunciation, subjectivation). The fourth chapter analyzes two contrasting cases of visualization design that exemplify concepts developed in Chapters One and Two. The visualizations will be discussed as both actants that entail other actants and processes, as well as assemblages in the production of subjectivity. The fifth chapter, through an analysis of a research-creation project, will apply the network-assemblage concepts in order to articulate a critical visualization practice. It will highlight productive aspects of the work and identify components that need further development. It will also expand upon the notion of visualization as an assemblage and what that means in terms of participation, affect, event, and performance.

Existing Literature

Design

This study will also connect with research in design that investigates the social role of designers, the projective role of design activity, and the ubiquitous use of the diagram as both operative concept and formal outcome. The social significance of design has been a perennial issue from at least the 1970s, with its emergence marked by Victor Papanek's (1972) *Design for the Real World*. This text and subsequent work by design scholars attempt to redirect design activity towards social justice and environmental responsibility (Dilnot, 1982; Manzini & Cullars, 1992; Margolin, 2002; Margolin & Margolin, 2002). Concern for the social dimension of design also extends to thinking of design and democracy (Bonsiepe, 2006; DiSalvo, 2012). Participation and accurate representation of the needs and desires of a given constituency are necessary parts of the design process in order for it to be responsive, relevant, and ethical (Akrich, 1992; Binder et al., 2011; Sanoff, 2008). This understanding has been fleshed out in contexts where labour and government imperatives were more emphasized, for instance in the case of Scandinavian participatory design in ICT systems (Floyd, Mehl, Reisin, Schmidt, & Wolf, 1989) and more recently in contexts where corporations or NGOs engage in co-creation (Sanders & Stappers, 2008) and human-centred design (IDEO, 2011). Also, the relational (i.e. social) nature of design activity and its outputs has more recently emerged within design scholarship (Blauvelt, 2008) with reference to trends in art practice, e.g. relational aesthetics (Bishop, 2004; Bourriaud, 2002).

Design practice, especially in architecture, has also seen a rise in the use of *diagram* as both part of the design process and the final outcome (Allen, 1999; Vidler, 2000). Several architects/theorists have taken on the work of visualization and its persuasive representation of space (Corner, 1999). Others have noted the projective qualities of diagrams used by designers and architects that float above indexical aspects of images (Allen, 1998). In this discourse, diagrams exemplify the shift in emphasis to a postcritical notion of design where the task of unpacking the relationship between the real and the representation is diminished in favour of a non-narrative and postrepresentational practice (Somol, 1998). Criticality in design has emerged as a distinct discourse that incorporates judgement as an essential part of design activity (Dilnot, 2008), an approach to acknowledging the disciplinary framework and limited set of premises of this activity (Agre, 1997), and as a practice that invites dialogue and reflexivity regarding design agendas (Dunne, 2005; Dunne & Raby, 2001). More recently, design and critical art practice have been framed as a set of techniques and perspectives that can be mustered to participate in an agonistic form of democracy (Mouffe, 2010) which raises awareness, creates community, resists oppression, or projects alternatives to important political issues (DiSalvo, 2012).

Information visualization and cartography

Critical cartography developed as a challenge to a once-dominant conception of cartography as an instrument of clear, accurate, objective communication embodying a technical authority which relegated other non-scientific maps to the realm of propaganda (Pickles, 2004). This present study, building on the insights made by critical cartography, places maps within

processes of map-making and map-using (Pickles, 2004) and conceives of maps as socially constructed and therefore functions of knowledge-power (Foucault, 1995) that produce as much as exclude subjects (Crampton, 2001; Harley, 1988, 1989; Pickles, 2004; Wood, 1992). Mapping has also been used to represent and intervene in the experience of the city (Cosgrove, 2006). Maps, for example by the Situationist movement, were also political tools for unmaking and playfully resisting the dominant forces of urban design and spectacle (Sadler, 1998; Vidler, 2006).

Cartography is at once a predecessor and an allied discipline to information visualization. The mapping of physical space has often overlapped with the representation of data on physical or abstract space. This is also evidenced by the fact that the work of Jacques Bertin (2011), a cartographer, has played a central role in the development of visual strategies for visualization. Bertin's work on the visual processing of information has been followed up more recently by research on heuristics and historical examples (Tufte, 1990, 1997, 2001, 2006). A history of the representation of visual thinking and visual representation of data has also been undertaken (Friendly, 2008). Within computer science, human-computer interaction, and psychology, a whole field has emerged that deals with the computational, interactive, and cognitive operations involved in the representation of large amounts of data and their use in decision-making. In this space, information visualization is often looked at as a problem space in which the main goal is to increase understanding while decreasing cognitive load. Information visualization is defined as the amplification of cognition through processes of pattern recognition and computation (Card, 1999).

What is often missing from discourse on visualization is critique (Hall, 2011). While critical work in cartography has made significant contributions, critical work in information visualization is still at its nascent stage. Exceptions include work that has looked at visualization as an extension of critical studies and aesthetics in new media and information art, for instance: visualization as a means of simplifying our access to the world (Manovich, 2002, 2010); the aesthetic dimension of visualization (Viegas & Wattenberg, 2007) as a practice that goes beyond analytics; or visualization as an art form that utilizes the aesthetics of administration (Sack, 2007). Other contributions come from science and technology studies. Visualization (i.e. the related fields of cartography, scientific visualization, data visualization, information graphics, information visualization, and visual analytics) has also been investigated through the lenses of actor-network theory, a key framework in science and technology studies resulting in an emphasis on work and mediation (Daston, 2014; Lynch, 1994). The relational operations of visualizations—in other words, the association, refinement, and movement of visualization objects—meant that visualization could be analyzed as an articulated form of representation through immutable mobiles (Latour, 1990).

The use of visualization, especially modes of cartography, has also been reframed from having a mimetic function to having a navigational one (Latour, November, & Camacho-Hübner, 2010). This introduces a shift in thinking that relies less on the importance of whether a representation corresponds accurately to a space or phenomenon and more on the calculations and negotiations made to navigate a given issue or terrain. Latour (2008a) brings this same logic to the realm of design and the practice of representing complex phenomena—and, as such, he catalyzed an important moment in which the worlds of design, visualization, and science and

technologies studies converge. In his 2008 address to the Design History Society, Latour reframes design as an activity that repairs and not necessarily revolutionizes, as a human activity that creates worlds of attachment and association, and as a necessary tool to represent these complex connections such that we make better future decisions. This represents a key body of work that helps frame the features of visualization but then opens the field to think through the practice of visualization as an assembly of human and nonhuman actants.

Methodology

As previously indicated, this study is conducted through an overview of the main contemporary currents in design theory and visualization theory as well as the analysis of a case study on current practices of expressive cartography and another case study of a research-creation project which attempts to work with the theoretical framework discussed above. Case studies are used to explore projects as instances of a larger scope of practices that can be thought of as critical visualization practice. The aim is to use case study methodology to generate an *analytic generalization* (Yin, 2009) that both supports the claim that critical visualization practice has some recent precedents and also represents a novel framework for thinking through design and visualization practices. These case studies are also examined through the theoretical framework elaborated in Chapters Two and Three that creates a bridge between actor-network and assemblage theory approaches to visualization.

The first set of case studies looks at two visualization projects: *Liquid Traces* and *Anti-Eviction Mapping Project*. Produced by Forensic Architecture (FA), *Liquid Traces* is a

visualization in video documentary form that accompanies a report on the failure of navy ships from various NATO countries to rescue 72 refugees (from the Libyan conflict) aboard a boat drifting in the Mediterranean Sea. FA, situated at Goldsmiths University and directed by Eyal Weisman, produces work that assembles heterogeneous data and creates new analytical tools to present counter-evidence in legal cases and media reports involving occupation, violence, and human rights abuses. The *Anti-Eviction Mapping Project* is an activist initiative that documents and visualizes the gentrification/displacement that occurs in the San Francisco Bay Area. This initiative is supported by the San Francisco Tenants Union and is used as a way of educating citizens, advocating for tenant rights, and supporting community members. For this case study, videos, online interactive maps, reports, interviews (i.e. text and audio), and photography have been used to analyze these two projects. The work itself lives largely online and it is through this platform that it is circulated and access is provided.

Using the theoretical framework outlined in this study, the second case study examines a visualization project that I am involved with. It is an ongoing project that predates the research done in this dissertation and continues to build through iterations. Up to now it has involved three facets: the orchestration of an outdoor architectural display as a public visualization tool; the collection and mapping of data related to homelessness; and events supporting both the production and dissemination of the visualizations. Processes in programming, visual design, interaction design, videography, data analysis, workshops, media relations, and social network management have all been important parts of the project. Although I was not directly involved in every aspect, I did initiate the project with Dave Colangelo and proceeded to develop the project through its successive iterations. This form of involvement, I believe, gives me a good overview

of the project, some knowledge regarding the specific processes undertaken, as well as some distance in order to assess its relative merits and shortcomings.

This case study also incorporates research-creation as a method through which to produce knowledge. Methodologically, research-creation represents a recently acknowledged form of scholarly work that attempts to broaden the scope of what is deemed knowledge by introducing new ways of intervening, producing, and disseminating. Research-creation has been described as an umbrella term that can involve different forms of combining creative practice with scholarly inquiry: research-for-creation, research-from-creation, creative presentations of research, and creation-as-research (Chapman & Sawchuk, 2012, p. 15). These forms are not meant to be exclusive categories but rather styles that emphasize one set of processes and goals over others. For the purposes of the current research, the research-from-creation style best suits the process undertaken. This style, as described by Chapman and Sawchuk (2012), uses the creative project—including the research to produce the work (e.g. finding suitable technologies, sketching, designing) and the performance of the work (e.g. event, maintenance)—as a source to propel the research. It should also be noted that this method highlights some fundamental issues within research. For instance, Chapman and Sawchuk (2012) suggest that this method is itself an intervention into the "'regimes of truth' of university-based research" (p. 6). When used in the creation of a dissertation, research-creation challenges dominant notions of scholarly knowledge, namely the presentation of quantifiable results and deliverables that meet established academic standards. Creative projects can often be multi-faceted, non-linear, and experimental, and can work through representational, performative, and affective dimensions—all valuable ways of knowing and experiencing but which often elude formal logics or measurement.

Outcomes

The focus of this work is design as a form of visualization. While the notion of visualization will be expanded, so will the notion of design. It is in this respect that this work will contribute to the field of design studies. As outlined above, the existing literature outlines a concentration of work around design as a social practice, and visualization and mapping as tools for mobilizing knowledge and establishing relations of power. The current work is an effort to fill a gap at the intersection of both these concerns. The expected contribution will take the form of adding a theoretical tool for understanding the role of participation and visual representation in design. This will include the notion of design and visualization as productions that involve both the development of processes as well as the creation of artifacts. This will also include a design-specific account of the relationship between representational practices and flat ontologies. Rather than look at the relationship between representation and space through a practice stemming solely from geography or sociology, this study will locate it within design practice. Design activity is uniquely situated to employ aspects from both of these other fields in the creation of artifacts that represent and produce particular spatialized material and communicative assemblies. For this reason, this study will contribute primarily to the field of communication and design studies through an articulation of three different—but very related—kinds of mapping practices: counter-mapping, participatory mapping, and expressive cartography. These types are not meant to create exclusive categories but rather sites of emphasis. For instance, counter-mapping may involve mapping data that is either underrepresented or often misrepresented.

These maps may make extensive use of existing data that are made available through governments, university research organizations, NGOs, or private sector organizations. Participatory mapping, on the other hand, may also endeavour to make visible forms of data that are rarely represented, but rather than employ official data it relies on the subjective experience of people involved in an issue or places being represented.

What I term *expressive cartography* is a practice that incorporates both publicly available data and participatory practices, but also attempts to mobilize the process either through events, feedback loops, and actions that aim to compose a new reality. This approach necessarily highlights the heterogeneous network of actors that need to be represented and, borrowing from Lazzarato (2003), make the creation of these worlds possible. Generally, these categories trace a trajectory from a critique of representation to a projective activity of *making possible worlds*. This trajectory has also been noted as a general shift from a focus on competence to one on performance, that is, from one that captures through mimesis, representation, and reproduction to one that expresses through enunciation, interaction, and flow (Kwinter, 1993). The contribution of this dissertation—critical visualization practice as expressive cartography—therefore highlights the map or visualization as both a process and an event. Beyond an object that is produced and circulates it is an object whose production assembles various actors (e.g. activists, designers, researchers, web technologies, visual elements, users, community members, sensors, cameras, open data, etc.) and through this production creates a particular public. This conception of expressive cartography also builds on a shift in the epistemological and ontological status of maps. This shift is characterized by an emphasis on the navigational rather than indexical (Latour et al., 2010) properties of visualizations (i.e. maps). It is therefore the focus on the actual

negotiation with specific markers and a shifting set of circumstances and positions (e.g. navigating a ship around hazards in a body of water) that allows us to rely less on whether a representation is true or not and more on the interrelationship between any number of indicators of position, orientation, speed, etc. This alternate schema of user-visualization can be applied to a wider set of contexts (e.g. design processes, urban planning, aesthetic visualizations) and provide a tool for rethinking how people use these kinds of representations to make decisions.

Conclusion

The following work, as outlined above, presents a framework for analyzing a form of design practice. Visualization has been studied through the lenses of science and technology studies, computer science, cognitive science, psychology, and geography. What this study will offer is a combination of insights from these fields in the service of articulating the social potential of visualization. This study will demonstrate how the social is expanded to include nonhuman actants and how this reiterates key developments in design theory. From this base a case will be made to include a larger repertoire of concepts to understand the production of subjectivity and its role in visualization. Finally, we will see how these notions are applied through a series of case studies ranging from visualization videos to mapping projects to architectural media and events.

Chapter Two: Design in Medias Res

Introduction

> What I am pressing for is a means for drawing things together—gods, non humans and mortals included. Why should this prove to be an impossible task? Why can the powerful visual vocabulary that has been devised in the past by generations of artists, engineers, designers, philosophers, artisans and activists for matters of fact, not be devised (I hesitate to say restyled) for matters of concern? (Latour, 2008a, p. 13)

Sociologist Bruno Latour's keynote address to the Design History Society[2] is a short but profound exhortation on the role of design in human society. The stakes are high—at a moment of global social, environmental, and economic crisis largely a result of misrecognising the effects of human industry. Design, both an engine of the industrial era and a basic human activity, can provide one way of surviving this crisis—namely, through its capacity to make things visible. But it is not a simple matter of improving the quality and accuracy of visual representations that is needed here. Rather, what is required is a reconsideration of what is meant by the verb "to design." Latour proposes two necessary strategies: firstly, reposition design along principles of association and attachment, and secondly, place a specific responsibility for explicitation on the design community at large.

2 Latour addressed designers and design scholars on the occasion of the DHS's Networks of Design 2008 Annual Conference in Falmouth, Cornwall, UK.

What effectively results from this endeavour is a specifically Latourian formulation of design as a *postcritical* practice that describes (i.e. visualizes) our entanglement (i.e. attachments) in networks of human and nonhuman actants. To design while acknowledging our entanglement is to *design in medias res*. This, in turn, prompts us to redefine what it is to design, given that there is no tabula rasa and that designing itself is always already defined through entanglements before one even begins to design. Within this context, visualization practice is valuable in two ways: first, it is a process by which to describe the nature of entanglements; second, it is itself a work of entanglement. Latour's exposition of design as way of understanding the way things are connected thus embeds visualization into design practice precisely because of its ability to *draw things together*.

Latour's reframing of design will serve as a catalyst to build a framework with which to understand and foster critical visualization practice. In order to do this, we must look at and extend three key concepts that support Latour's position: the links between design, modesty, and criticality; matters of concern as a product of artificiality; and the process of design as visualization. This will also involve using Latour's keynote as a starting point to connect the tenets of his methodological and philosophical work to design. Latour's keynote can be understood as an official acknowledgement of the major importance of actor-network theory (ANT) and more generally, of Latourian thought to design.[3] This is evidenced in the list of presenters in the proceedings of the conference—several have gone on to incorporate forms of

3 This talk is situated a few years after Latour's two important exhibitions at Zentrum für Kunst und Medientechnologie (a world-renowned new media museum in Karlsruhe, Germany): Iconoclash and Making Things Public. These were very ambitious exhibitions with a vast array of artist-designer-researcher projects that deal with the transition from a critique of representation to an advocacy of explicitation. It is important to note this sequence of events because the exhibitions themselves act as manifestations of Latour's basic thesis in the keynote.

material semiotics (i.e. ANT) to the ethnographies of design discipline (Yaneva, 2009), implementation of ANT in design pedagogy (Ward & Wilkie, 2009), and ANT perspective towards design practice (Nickelsen & Binder, 2008). The following chapter will endeavour to provide a close reading of the keynote's text and analyze the connections between Latour's concepts of design, criticality, attachment and explicitation, and contemporary design work that flesh out this particular Latourian philosophy. This will serve to launch into a discussion, in the following chapters, on how visualization projects bring networks and assemblages into being.

Why is it important to look at Latour's specific influence in the area of design? Latourian thought has pervaded many disciplines including anthropology, science and technology studies, organizational studies, and philosophy—to name only a few. Reasons for this ubiquity can be found in Latour's sustained use of the actant-network concept to advocate for a sociological practice that attends to the micro relationship between humans and nonhumans. This theory/method is well-suited for an era that spans over two decades and which has seen the fall of the Berlin wall and dissolution of the Soviet Union, an unprecedented rise in the connectivity between people and things via telecommunication and data networks, and an increasing awareness of global environmental crisis. The notion of connectedness, the importance of nonhumans shaping human fates, and the collapse of a major ideological dichotomy are major threads throughout Latourian thought. In the field of design there has been a surge of interest in systems thinking, human-technology interaction, anthropology, and ethnographic methodologies—all of which are echoed in Latour's basic framework of relational thinking, technologies of mediation, and an ethnomethodological approach. Ultimately, the most interesting aspect of the Latourian contribution to design is the problematic his work raises in the

crisis of representation, nonhuman participation, and postcritical practice. One of the ways this is played out is in information visualization and critical design practice where description and critique are the two dominant operative modes, respectively.

The title of Latour's talk, *A Cautious Prometheus? A Few Steps Toward a Philosophy of Design (with Special Attention to Peter Sloterdijk)* is informative in two ways: first, it revises the aim of design through the trope of Promethean hubris; second, it points to a new philosophy of design that incorporates Sloterdijk's notions of *explicitation* and envelopes. It also posits a relationship between modesty and construction that requires us to attend to the socio-technical relationships needed to support life.

Latour evokes the notion of *things* as a central concept for what design can and should do. Things are assemblages of other things. Latour echoes Heidegger's use of thing (Heidegger, 1971) where it references a gathering. Things are a very important designation for Latour because of this double meaning of artifact and gathering. In this ontology, objects are closed and settled while things are active and contested. *Ding* (Old English), the root word of thing, also refers to a parliament or assembly of heterogeneous elements. Latour has made it his project to promote a political dimension of artifacts that acknowledges the nature of their assemblage as well as the sphere created by controversial things (Latour, 2005a, p. 12). Things are therefore not simply matters of fact that are settled, stable definitions that emerge from natural occurrences, but rather things are matters of concern where multiple parties (i.e. humans and nonhumans) are actively engaged in the process of their composition.

What we normally think of as matters of fact are inherently political for they are composed of the struggles and negotiations of allies, inclusion, representation, and power. They are better

understood as matters of *concern* which require representation such that they allow inspection. Reiterating a call he makes in the introduction to the *Making Things Public* exhibition and catalogue/book (Latour, 2005a, p. 13), Latour's keynote articulates a need for an aesthetics of matters of concern that goes beyond the transparent and discrete depictions of matters of fact (Latour, 2005a, p. 13). In this keynote he explores design's central role in the process of representing matters of concern. Ultimately, Latour is proposing that the aim of design should be to assemble or draw things together in such a way that it aids human cognition, which would presumably lead to better decision-making. In order to understand Latour's argument we must contextualize his concepts within the wider landscape of design theory. To this end, the rest of this chapter will trace the connections and disjunctions between contemporary thinking in design, Latour's innovation and incorporation of the notion of design, and the role of design as representation.

Design, Criticality, and Modesty

For Latour, designing involves a basic humility in the face of complexity. This means that revolution is not desirable, that starting from a blank slate is not possible, and that separation is an illusion. It is because of these ostensible qualities that Latour holds design in high esteem. In his definition of the term, design mirrors Latour's own set of methodological principles which have been formalized within the *actor-network theory* (ANT) approach in sociology. If we compare specific aspects of his ANT-approach to concepts in design theory we will be better prepared to understand his contribution to the field.

To begin with, Latour's notion of design, as he explains in his keynote, is transplanted from his French experience with the term. In English, *restyling* better approximates the French etymology of design. Limiting the essence of design to surface effects would rankle many designers since there has been a long legacy of thinking of design as form that follows function, and therefore thinking of it as a discipline that attends to the work performed and the proper representation of content. Presumably, mere styling or restyling would be the focus of fashion and branding—hardly the disciplines we would expect to help humanity come to terms with its finitude. But for Latour, "style" is used as a way to understand the manner in which things are composed—fashioning. Design, in this sense, is central to Latour's constructivist or compositionist framework which prioritizes the gathering of objects in a heterogeneous network as a site of inquiry. How something is composed, among the endless other ways it could be composed, is the focus of *design as style*.

Design, for Latour, always arrives at a situation or process that is already under way. Similarly, the ANT sociologist arrives at a site to create an account which builds on previous accounts and adds further detail to the understanding of how a particular issue is composed. This is not far from other understandings of design. For instance, it echoes the notion of *vormgever*, a Dutch term often used to mean design and which suggests *designing as form-giving.* The assumption is that there are already material components that should be arranged in order to give the thing a recognizable form. We can find a compatible ethos in the compositionist aesthetics of creating form through *bricolage*, *collage*, and *assemblage*. These are art practices that privilege the juxtaposition of elements to create compositions of heterogeneous networks. The aggregate

form holds the pieces together, but upon closer inspection a complex interplay between the various and often found elements is revealed.

Restyling and refashioning can be contrasted to another dominant definition of design—namely, planning action.[4] Planning is a basic human activity, as is the underlying logical requirement that we plan action in order to change a given situation. Herbert Simon's often cited notion that: "everyone designs who devises courses of action aimed at changing existing situations into preferred ones"[5] (Simon, 1996, p. 67) has been paraphrased and reinterpreted almost infinitely in attempts to come to grips with what designing is as a discipline (see Schön, 1983). Design, as the planning of action, has resulted in artifacts and environments that are intended to meet well-defined goals. Victor Margolin (2002, p. 107) notes that this notion of design as conception and planning of the artificial is deeply informed by a positivist framework that positions nature as the ground on which a science of the artificial (i.e. design) is applied. At first glance, the *planning of action* version of design seems to be largely different from Latour's notion of restyling. But this is true only in the degree of emphasis.

While the planning paradigm of design is indebted to a strong rationalist and positivist approach it nevertheless focuses on the description and ordering of connections, translations, and processes involved in a project. For instance, Simon (1996) outlined a model of design and proposed that an essential element of design was the establishment of a hierarchy through the

4 Etymological treatments of the word design often resort to the Latin roots that denote marking out. This root accounts for the dominant notion of design that points to making a mark and to planning—both to an aesthetic (i.e. graphic) dimension as well as a cognitive (i.e. strategic) one.

5 Design researcher Nigel Cross (2011) suggests that although everyone is a designer (in that they may create a plan of action to change things from how they are to a preferred state), professional designers have particular skills that allow them to be very sensitive to their environment (including objects, texts, etc. that relate to the project) and therefore allow them to synthesize and translate this kind of data into formal design proposals.

ordering of subsystems within systems and sub-functions within functions. It is only through this rational and stable structuring of elements and actions that an analysis of efficiency can be performed. This understanding is also supported by Victor Papanek (1972), who posits that "design is the conscious effort to impose meaningful order" (p. 6). Whether this is the ordering of shapes and lines on a sheet of paper or the gathering of materials to create a tool, the designer engages in a quasi-rational process of selecting a goal and a means of achieving that goal.

If design has been pictured as a rational process through which objects or processes are carefully planned, it has also been pictured as an intuitive process that involves the cultivation of spontaneous flashes of insight and creativity (Frayling, 1993). This intuitive process which leads to creative leaps has more recently been referred to as *abductive thinking*[6] in design (Martin, 2009). Architectural theorist Robert Somol also highlights the virtue of abductive thinking, although he doesn't call it that. Somol refers, instead, to a *eureka moment* when a designer suddenly registers the ecological, community, etc. in the field (Somol, 1998). Somol notes that "Eureka results from a repetition between quotidian and disciplinary experience" (Ulmer quoted in Somol, 1998)—between the experience of the banal and the intent of design. But perhaps the more instructive version of this notion of design process is *aesthetic cognition.* This conception is highlighted by Susan Buck-Morss in the work of Theodor Adorno and Walter Benjamin, and more recently used by Clive Dilnot (1982) to help define the role of design in regard to the invention and implementation of technology. Aesthetic cognition in this context means being able to handle the social, technological, logical, and affective aspects of a particular design

6 This follows pragmatist philosopher Charles Peirce's notion of abductive reasoning, which he posits as a third kind of reasoning beyond inductive or deductive reasoning.

problem—and this relies on the sensibilities of an artist or designer. Dilnot (1982) suggests that "Design, by contrast [to engineering, presumably], is a multi-dimensional activity characterized precisely by its ability to synthesize heterogeneous criteria from a number of different orders (technical, economic, humanistic, etc.)" (p. 144). The planning process in design is therefore parallel to an aesthetic process that creates connections.

It is this kind of design cognition that maps onto the compositionist ethos championed by Latour. Aesthetic cognition is useful to see how a designer or artist can fathom the multitude of connections amongst a variety of heterogeneous actors. More than abductive thinking or the eureka moment, aesthetic cognition signals a particular aspect of how design as a cognitive process can serve as an important capacity to assemble disparate elements, considerations, and issues in order to solve a problem. But this is not simply an ineffable or magical event—it is also part of how design, more recently, has begun to define itself as a field. From a pedagogical perspective, for instance, Bruce Archer (1979) positions design as a viable third area of education that makes a triad with science and humanities (p. 19). As a kind of antidote to the problem of two cultures (i.e. science and humanities) identified by C.P. Snow (1993), Archer suggests that design focuses on the making and doing of human activity and thus fleshes out the area left behind by the focus on measurement in the sciences and the focus on interpretation in the humanities. He states that,

> where Science is the collected body of theoretical knowledge based upon observation, measurement, hypothesis and test, and the Humanities is the collected body of interpretative knowledge based upon contemplation, criticism, evaluation and discourse,

> the third area is the collected body of practical knowledge based upon sensibility, invention, validation and implementation. (Archer, 1979, p. 20)

Design in this sense is an activity that combines an aesthetic and creative process with an evaluative and performative one.

The humanist perspective has been a fundamental aspect of design. Despite Latour's dedication to having us accept a flat ontology that puts human and nonhuman agency on equal footing, he does not discount human interpretation as being a dominant force. Latour recognizes this problematic dichotomy and has even made efforts to combat it.[7] In fact in his keynote, Latour identifies the symbolic, interpretive, and aesthetic dimension of design as a great advantage of the concept. Creating meaning and interfaces between humans and their environment is a central concern. For instance, Gui Bonsiepe suggests that design can augment our perception of the world. For Bonsiepe (1997), design is the domain of transforming the *present-at-hand* to the *ready-to-hand* (p. 2). Using Heidegger's terms, Bonsiepe states that design is or should be in the business of increasing cognition—in turning things that are simply known (i.e. present-at-hand) to things that are acted through (i.e. ready-to-hand). For Bonsiepe, design is concerned with creating an interface for humans in order to work with other people and artifacts.[8]

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7 Latour's massive open online course (MOOC) on Scientific Humanities at Sciences Po attempts to bridge this divide by directly applying an ANT-inspired humanities analysis to issues in science and technology (see http://www.bruno-latour.fr/node/532).

8 Bonsiepe is particularly qualified to suggest that design can aid in revealing our connectedness. He was the interface designer of the Cibersyn economy management system developed by cybernetician Stafford Beer for the Allende socialist government in Chile in the early 1970s.

The human interpretation of design objects has also been a major concern in design research. This is not surprising given the central role of designing objects for human use and consumption. Interpretation, as a human activity that relates a human subject to a given object, is predicated on generating meaning. It is with this premise that design has been analyzed through rhetorical (Buchanan, 1985) and semantic (Krippendorff, 2006) frameworks. Richard Buchanan (1985), for instance, privileges the capacity of design to manage meaning when he envelops the ultimate aims of product and communication design under the notion of design as rhetoric (p. 8). By applying rhetoric as a framework Buchanan is able to describe designed objects as communicative and as forms of persuasion. Designed objects declare themselves to the user as things to be considered useful for a particular task (Buchanan, 1985, p. 20)—the crafting of this declaration and its reception by a user is the realm of design. In its capacity to help humans interpret the world and organize human activity, design ultimately leads to the arrangement of natural, social, and technological systems. Buchanan suggests that the increasing predominance of these systems and our reliance on them to organize activity and sustain life has begun to blur the distinction between human and nonhuman. It is similar to Latour's contention that, in this sense, design both works to perform (i.e. maintain) and represent (i.e. describe) these heterogeneous assemblages insofar as they are considered part of humanity's entanglement in an artificial world.

Criticality in Design

A crucial dimension of the symbolic and material worlds that Latour attempts to negotiate in terms of the cultural and natural, or the representational and performative, is the question of *criticality*. The critical project, for Latour, has lost much of its utility—especially in the face of our collective ecological crisis. For this reason Latour resorts to design as mode of refashioning. Yet, an etymological inquiry reveals a very different process closer to critique. According to its Latin root, to *design* is to *mark out*—to make a mark and thereby separate what is inside from what is outside. This root meaning has been extrapolated to explain what a designer ultimately does—that is, to separate out *what is* from *what should be* (Dilnot, 2008). Through a consideration of the critical in design we will see that in fact there are commonalities that support Latour's position but also extend it.

Inherent in this process is a *critical judgement* that results in the establishment of a need. This judgement occurs through the ordering of priorities of what should be and the separating of what is included in the scope of the project. *What is* therefore represents the problem state and *what should be* represents the solution state. This is a dominant notion of design that privileges problem-solving, and perhaps more importantly problem-framing, as a central goal. Problem-framing has a normative dimension in that it requires an establishment of priorities and an assessment of needs, and implies a dissatisfaction with the status quo. It also implies a progressive movement forward from the *what is* to the *what should be*.

Within design, the critical stance has been expressed in at least two different ways. One is more closely aligned with the tenets of Critical Theory.[9] Emancipation through a critique of mass media is seen as a primary strategy. Examples in visual design include the work of Jan Van Toorn and Jonathan Barnbrook. These designers work to unveil the mechanisms of cultural hegemony by which ideology is maintained. It tends to presuppose a duped citizen or consumer that is in need of a critical distance between images and reality. The other position treats critique as a fundamental aspect of design process. According to Clive Dilnot, the *critical* move is an inseparable part of designing in that it constitutes the act of deciding between what is and what should be. Discerning what is lacking in a given state of affairs is to already decide what could be; this therefore becomes the basis for informing the direction of the design activity. Dilnot (2008) states that "perception, not realization, opens the game [of design activity]; that which is in the gift of the designer is, therefore, in the first instance, a critical apperception" (p. 179). This involves both reconciling what is perceived with what is already known and acknowledging the designer as intervenor in that situation.

The incorporation of critical thought concerning rationality and humanistic goals into design pedagogy marks a pivotal moment in the development of the design field. A key example of this can be found in the Ulm School of Design (an unofficial successor to the Bauhaus): the school made it a founding principle to consider design a moral act. First among the criteria for any endeavour was the assessment of how the project would benefit humanity. The only reliable

9 Critical Theory, from the Frankfurt School tradition, has been described as a practical endeavour that aims "to liberate human beings from the circumstances that enslave them" (Horkheimer, 1982, p. 244). It is predicated on a notion that the world is in ruins, that everywhere humans are in chains, that there are universal concepts of human dignity and welfare, and that change can be effected through a rational and rigorous critique of these conditions.

way seen of achieving this goal was the rather strict application of an objective, rational design methodology. Human need was analyzed and incorporated into the entire process of concept generation, form-making, and production. Inevitably, the rationalist doctrine that pervaded all of the Ulm school's design pedagogy placed minimalism higher on the moral scale as it was said to embody a sense of authenticity. Surface was considered only insofar as it facilitated the communication of the essence of the material or the functional use of the object. Both "truth to materials" and "form follows function" are maxims in art and especially design which signal this commitment to authenticity and an eschewing of illusion or effects. Reducing clutter and producing strong forms that communicated simply, held a promise to transcend language and culture.

Universalist design strategies attempted to create a visual language that transcended any specificity to location. The minimalist aesthetic evident in most of this kind of work employs a visual language that operates according to principles of Gestalt theory in order to achieve an immediacy of perception. It was believed by Ulm practitioners that a design process that made efficient use of the connection between object, visual stimuli, and cognition could orchestrate a common and raw aesthetic experience that was universally accessible regardless of ethnic, social, or geographical differences. This can be seen as a response to the aftermath of World War II. The shadow of mass devastation across Europe put a new agenda in the minds of these designers—fix the world (i.e. create order in the world) through a rational application of design. But this impulse lost out in the mid-twentieth century with the advent of designed obsolescence, conspicuous consumption, and Moore's law of computational power, which is characterized by rapacious production and disposal of designed objects. In the period that has followed the world

wars, design has been the purveyor of perceived difference (e.g. between products and brands) and the creator of new needs in the service of a growth economy that requires constant renewal. Gianni Vattimo (quoted in Hill, 2007) suggests that "in a consumer society continual renewal (of clothes, tools, buildings) is already required physiologically for the system simply to survive. What is new is not in the least 'revolutionary' or subversive: it is what allows things to stay the same" (Design Humility section, para. 3). Needs in this context become effects of the system and thus help reproduce the system. However, the ecological imperative that has come to pervade much discussion of technological development and consumption in the form of sustainable practices has forced many designers and theorists to expand the scope of the system to include the needs of biological life to survive on Earth. This reassessment of needs as well as where and what design is oriented towards represents a breakdown in the conventional logic of design that mirrors a trend in critical thought.

The critical project has had one of its most ardent critics in Latour. At the core of his argument is the assertion that critical theorists (and critical sociologists) have resorted to generalized concepts that lack the precision that would make the critiques hold (Latour, 2004b). He also argues that critique has emphasized iconoclasm over a careful understanding of how representations enable and make durable specific arrangements of people and things (Latour, 2004b). Critique for Latour has become an industry for the right as much as for the left; for example, the World Trade Centre is said to have collapsed under the weight of capitalism's nihilism (according to Baudrillard) and the "controversy" of climate change is perpetuated by U.S. Republican lobby groups. Critique has become too quick and too thoughtless to carry the same import as before. Latour argues that contemporary forms of social critique lack the

empiricism that would ground their claims and instead rely on preconfigured explanations that too quickly resort to notions such as power, society, or discourse which tend to undermine the complexity of phenomena but are nonetheless used to sway opinion one way or another.

A fundamental problem in critical theory, according to Latour (2004b), is that the beliefs of the ethnographic informant (i.e. the everyday person, the subject, the participant, or the user) are at once taken into account and summarily discounted as myth and reframed as expressions of larger dynamics such power, race, gender, etc.—all part of critical sociologist's toolkit for explaining cultures and society. A similar critique in the social sciences and humanities is registered by Nigel Thrift (1996) when he states that "a hardly problematised sphere of representation is allowed to take precedence over lived experience and materiality, usually as a series of images or texts which a theorist contemplatively deconstructs, thus implicitly degrading practices" (p. 4). This problematic centres around the contradictory nature of how the subject and object are treated. In one scenario the object is an empty vessel that simply reflects the subject's desires (e.g. social constructivism). In the other scenario the subject is overdetermined by the objects (e.g. naive positivism)[10]. Instead Latour argues for raising the informant's account to the same level of importance as the sociologist.

A trend that parallels Latour's critique has also emerged within design—namely, user-centred design. In contrast to the design of functional systems where an operator must conform to the requirements of the machine, a human-centred approach attempts to align the interfaces of

10 A similar observation has been made by Jacques Rancière (2009), who traces the notion of a populace dominated by false imagery to a mid-nineteenth century development that included the lamentation for illiterate individuals being bombarded by too much media. Too much imagery and too much text were being launched at simple folks that had not had the benefit of a formal education that would enable them to decode and discern the good from the bad.

machines to the preexisting capacities, dispositions, habits, and perspectives of human users. This is all in the service of creating designed artifacts that make sense to the stakeholders. The bringing in of context (including humans) has been a feature of design research, methodology, and practice for over 50 years. The way that context has been incorporated has differed: from demographics, market analysis, interviews, focus groups, and user-testing; to more recently, ethnography and participatory methods. Including the viewpoints of users and consumers, as experts in their own experience and context, has been a standard method for creating meaningful messages, products, environments, and services. This aligns directly with Latour's adherence to ethnomethodological principles in which the literacies, capacities, and expertise of people to navigate their material-social worlds is respected and deferred to when analyzing practices in culture.

Latour's prioritizing of the participant's point of view is also consistent with his focus on the details that compose a network of relations. Therefore, a stress on the relational structure of networks of actors is at the core of what he offers as an alternative to critical theory. Latour takes up a strategy related to collage—assemblage—as a way out of the bankruptcy he detects in the critical enterprise. By describing networks of actors as assemblages (borrowing from Gilles Deleuze and Félix Guattari), Latour underscores the importance of associations between nonhumans and humans. This borrows from assemblage as an art strategy—an understanding that avoids teleologies and rather responds to the contingent relations between elements in the creation of a whole. Rather than bring down false representations and negate their claim to truth, assemblages highlight the careful piecing together of heterogenous components and reveal instead their connectedness.

Modesty through Situatedness

A focus on the perspective of the participant leads to an emphasis on the nature of any actant's *situatedness*. Rather than seek a transcendent logic, Latour—along with Deleuze and Guattari for instance—seeks an emergent logic. Where a transcendent logic requires a critical distance to ensure objective value, an emergent logic requires proximity. Situatedness, emergence, and proximity share a common thread that in Latour's logic amounts to an attention to details. It is for this reason that Latour favours the design paradigm. In his lexicon, design is about craft, quality expressed in the attention a designer gives to the small contingent elements of a composition. We are reminded of this reprioritizing by Katherine Hayles (1995) when she asks, "what happens if we begin from the premise not that we know reality because we are separate from it (traditional objectivity), but that we can know the world because we are connected with it?" (p. 48), For Latour, the need to apprehend, represent, and intervene—in other words design—with all its contingencies, processes, and complexity, also necessitates a disdain for criticality. When designing in assemblages and networks, the virtues of detachment and distance may be replaced by attachment and proximity.

It should be noted though that this conception of design, and by extension the designer, has not been the dominant one over the past several decades. Instead, the role of the designer has more often been framed as problem-solver, outsider, expert, consultant, observer, etc. which positions the designer outside of the thing being investigated and designed for. Not being implicated in the current situation creates a distance that ostensibly allows a designer to gain a

certain level of objectivity. They are brought in to help define the shape of the problem, recommend plans of action, and often implement a part of those actions. This problem-solution paradigm of design has been critiqued for assuming that the designer could objectively gather all relevant information to frame/define a problem and then combine/evaluate elements in order to produce an executable solution that would fully satisfy the real problem (Buchanan, 1992, p. 15).

Instead, Buchanan offers the notion of *placements* as an integral part of the design process. Buchanan (1992) explains, "What is regarded as the designer's style, then, is sometimes more than just a personal preference for certain types of visual forms, materials, or techniques; it is a characteristic way of seeing possibilities through conceptual placements" (p. 13). Buchanan alerts us to the situatedness of the designer within a particular set of skills or dispositions (e.g. visual, material, performative, systemic). Rather than limit the designer in achieving an objective distance from the problem, this disposition allows the designer to view particular aspects of the problem that afford places of intervention (Buchanan, 1992, p. 10). Acknowledging the designer's style (i.e. placement) is consistent with the notion of flattening the hierarchy between actants—whether they are humans, designers, users, or nonhumans. It acknowledges the particular way that components, including skills, knowledges, capacities, etc., are assembled—a Latourian form of re-styling that extends the productive processes of the designer.

Situatedness also lends itself to a particular cognitive process for designers. Looking at the designer's subject position in design activity, Dilnot (1982) uses the notion of design cognition to address how the designer synthesizes a heterogeneous set of concerns, processes, and techniques. Dilnot ties the concept of design cognition to the aesthetic cognition that was defended by Adorno and Benjamin. Aesthetic cognition—following Susan Buck-Morss—is

more adequate than rationalism because "in it subject and object, idea and nature, reason and sensual experience were interrelated without either getting the upper hand—in short, it [aesthetics] provided a structural model for 'dialectical,' 'materialist' cognition" (Dilnot, 1982, p. 145). Yet within this situated synthesis of varied concerns in design process, Dilnot also observes that an inseparable phase is the analysis that determines a thing to be or not be desirable—that is, a critical move. This resonates with Simon's (1988) original definition which placed design as part of the analysis needed to make plans that change *existing situations into preferred ones*. But Dilnot (1982) posits that a renewed sense of criticality is needed in design—one that perceives "truth" and translates this into a synthetic composition acknowledging its status as a configuration (p. 179). Criticality in design requires that we—designers especially—evaluate "the sufficient or insufficient character of the artificial" (Dilnot, 2008, p. 184). This echoes Latour's (2008a) suggestion that we look at the construction of assemblages in terms of good or bad quality. For Dilnot, this is a moral question because we are now in an era in which all doing involves transitive action, that is to say, that all action has repercussions in the world and therefore, all action, and especially design action, is a moral act (Dilnot, 2008, p. 184). For Latour, as with Dilnot, the problems of truth–falsity should give way to a greater emphasis on the good–bad quality of configuration (Dilnot) or network/assemblage (Latour). For this reason design is an appropriate lens through which to look at socio-technical arrangements. As Latour states, the "advantage of the concept of design is that it necessarily involves an ethical dimension which is tied into the obvious question of good versus bad design" (2008a, p. 5). Since a central concern of design is the capacitating, framing, and delegating of action, it follows that Latour

focuses on performance rather than representation. Therefore, for Latour criticality must give way to a pragmatics of design process.

Latour's framework embodies many of the tendencies often categorized under the terms pragmatism,[11] postcriticality,[12] or non-representational theory (NRT). While these terms are not interchangeable they do overlap in the way they privilege experience and complexity over representation. NRT is particularly instructive for contextualizing Latour's thought on design (and visualization) because of the emergence of this theory in the field of geography—a field dedicated to the representation of human interaction with space, one form of which is cartography and visualization. It draws from and expands upon Latour's framework by advancing a deep skepticism towards the valuation of representations over lived practice. Everyday practice, affect, and performance—aspects that historically have either escaped representation or been deemed inconsequential—are emphasized as sites of great importance for how people make sense of their lives, interact, and structure their world. For Nigel Thrift (1996), NRT's originator and principal theorist, a consideration of context is also a key element in understanding how humans act and make sense of the world. But rather than treat context as background, Thrift suggests that it be brought to the foreground and treated as an active mediator

11 This can be seen as part of a larger pragmatist turn, identified by Alvesson and Skolberg, that also coincides with a renewed interest in American pragmatist thought (e.g. Peirce, Dewey, Whitehead, James). This resurgence has been championed by Latour as an alternative thread of philosophy that avoids the nature/culture split by pursuing a form of radical empiricism. It is also a source for Latour's suspicion of the iconoclastic impulse for it obviates the reliance on reality–appearance distinction in favour of understanding interrelated action, process, and performativity.

12 This term has been most popular in discussing architectural theory and practice—especially in contradistinction with critical practice. Critical is concerned with self-referentiality, dialectics, and the conditions of representation, and postcritical seeks to contribute to a production and projection of collective activity (Somol & Whiting, 2002, p. 74). Michael Speaks (2005), a proponent of the postcritical turn, suggests that critical practitioners were in search of truth that lay outside of commercial reality. It has also been noted that many practitioners that work through a projective or postcritical mode very often eschew continental philosophy and critical theory in favour of pragmatics (Baird, 2004; Speaks, 2005).

in human activity. Similarly, these NRT concepts have been taken up as a kind of Latourian pragmatism in design. For instance, Albena Yaneva (2012) echoes Latour's embrace of pragmatist thought and applies it to the field of design and architecture. For Yaneva, the pragmatist approach embraces complexity and avoids reductivism. She emphasizes, like Latour, the need for a renewed sense of realism that attends to how technological and material agencies frame human activity.

Latour's logic of situatedness is fundamental to his call for modesty in how we describe (i.e. sociology) and intervene in (i.e. design) the world. To acknowledge the complexity and non-linearity of ecological systems and the multitude of actions that create knowledge is to assume a humility towards both one's capacity to effect change and one's ability to represent the totality of interactions. But adopting the position of the modest designer needs to be considered carefully in order to not reproduce some of the same problematics it is intended to address. While modesty may be a way of countering the hubris of a capitalist, industrial society it cannot translate into either a withdrawal from the action or a willingness to become invisible in the process of an intervention. This would perpetuate a particular form of modesty that, according to Donna Haraway, is fundamental to a rationalist and objectivist production of knowledge. Haraway (1997) offers a feminist critique of this form of modesty that is necessary if we are to embody this attribute as designers. Modesty, in one very particular sense, has been the modernist and masculinist mode that removes the body—and women, historically—from the act of witnessing scientific discoveries. In this way, modesty has operated as a safeguard *against* situatedness and other knowledges in order to reduce scientific experiments to their most essential elements and increase impartiality. But Haraway insists that modesty can be rewritten or mutated to not repeat

this pattern of domination by insisting on the validity of one's location, exclusion, partiality, and experience. The modest witness "is about telling the truth, giving reliable testimony, guaranteeing important things, providing good enough grounding—while eschewing the addictive narcotic of transcendental foundations—to enable compelling belief and collective action" (Haraway, 1997, p. 22). The value of situatedness lies in how it reorients the validity of particular knowledges that have historically been marginalized. By extension, the value of modesty in design lies in highlighting the specificity of one's actions and their entanglement with other actants.

Latour suggests that the spread of the term design coincides with the fact that there is more to do than ever before. By this he means that our ecological crises have prompted us to look at ways of remaking our collective life (Latour, 2008a, p. 7). The paradox lies in the fact that the design problem has become greater than ever before in human history and yet the approach advocated by Latour is that of a modest designer. The *cautious-Promethean* position—which advances an iterative, reparative (and descriptive) mandate for design in a world characterized by the interplay of networks or assemblages—thus leads to a reworking of criticality. The modest designer doesn't appeal to transcendent, non-located knowledge in a gambit to revolutionize the world. The modest designer exhibits not a modernist attitude that heroically leaps forward but a cautiously radical attitude that emphasizes "modesty, care, precautions, skills, crafts, meanings, attention to details, careful conservations, redesign, artificiality, and ever shifting transitory fashions" (Latour, 2008a, p. 7). It is with these designerly traits—criticality and modesty—that we can begin to attend to the ways that particular matters are represented and configure the world.

The postcritical is thoroughly non-Promethean. It does not seek revolution or rupture. Instead it seeks to repair, re-style, iterate, modify. This approach is not without its critiques and contradictions. For instance, Alvesson and Skoldberg (2009) note that it was Lyotard who provides the initial impetus for a pragmatic turn which accepts the inevitability of capitalism and advocates working within these existing constraints in what he terms a *temporary contract* (p. 192). Rather than provide critiques of meta-concepts such as capitalism, pragmatist and postcritical designers strive to embed themselves in the context, willingly participate in the market economy, and produce change from within. A similar critique has been launched at Latour and ANT in general. Law (2009) notes that ANT has been criticized for privileging a masculinist, functionalist, and entrepreneurial perspective of human and nonhuman assemblages which neglects the politics of access and accounts of participants who are not deemed valuable enough to be documented. Although these characterizations may in some cases be accurate, Law (2009) maintains that ANT is diasporic in that it (or at least main concepts within it) has been taken up in a multitude of other fields that add and/or replace concepts that address these shortcomings. It is in this spirit that part of this critique will be addressed by incorporating an assemblage approach to ANT concepts. Specifically, the work of Deleuze and Guattari will be used to describe both the production of subjectivity within assemblages (i.e. networks) and the way networks as assemblages offer more flexible ways of analyzing how attachments and associations proliferate.

Matters of Concern from Artificiality

Design, for Latour, offers a form of criticality and action that is up to the task of confronting social and ecological crises. For this reason, Latour (2004b) states that

> the critical mind, if it is to renew itself and be relevant again, is to be found in the cultivation of a stubbornly realist attitude—to speak like William James—but a realism dealing with what I will call matters of concern, not matters of fact. (p. 231)

In Latour's lexicon, *matters of concern* are the assemblages made of complex ecological systems and discursive networks and *realism*[13] is a function of how connected something is within a network of actants and how traceable those social and material connections are. We can extrapolate from this that the quality of a design is therefore determined by how it connects and how well those connections are made. In his keynote, Latour extends this logic to encompass what design can and should do, and so recommends that we focus our attention on the artificial. He states that "artificiality is our destiny" (Latour, 2008a), because it is the site where humans continuously re-configure themselves and their environments in order to survive.

The artificial, as the outcome of human activity, is therefore synonymous with dominant notions of design. Simon (1988), in an effort to define the artificial and ways of studying it, argued that the *science of the artificial* is the science of design since it is the study of how humans make decisions (i.e. make plans) about how to live within their environment (see also Margolin, 2002). Ultimately, the notion of the artificial problematizes Simon's premise of design

13 Realism is an important concept to understand with Latour's lexicon. It is rooted in a radical empiricist tradition that emerged from pragmatist thought (e.g. James, Whitehead, Dewey, Peirce).

as the planning of action. This rationalist approach to design is predicated on a closed system where causality can be relatively easy to apprehend. Glen Hill (2007) suggests that there is in fact a paradox in the concept of design that hinges on the notion of causality. Hill explains that our ability to understand causality leads us to think that we can intervene in order to bring about a more beneficial outcome. The growing realization that causality is impossible to predict beyond extremely local dynamics threatens to remove the fundamental procedure by which design can say or *do* anything. Hill also notes that within design there has historically been a certain hubris insofar as the abilities of the discipline to make things better are concerned. Much like Latour's call for modesty, Hill advocates for a humility that promotes a good amount of hesitation at the prospect of designing something new. This modesty in the face of the artificial is predicated on acknowledging our inability to completely understand, predict, and control interactions between human and nonhuman worlds—where the human world is social, cultural, and artificial, and the nonhuman world "natural."

Victor Margolin (2002), for instance, notes that Simon put nature and the artificial in terms analogous to nature and culture (p. 108). Culture therefore is the realm of human action expressed through design—not just control of technology, as Dilnot put it, but also the control of the natural environment. According to Margolin though, culture and nature (as the ground for the real and therefore meaning) have in fact been blurred through the postmodern notions of the dissolution of metanarratives and the rise of simulacra. The lack of an overarching and guiding story of progress or logic—by God or otherwise—plus the endless simulation and representation that has ultimately separated us from any kind of reality, has led to a conflation of culture and nature (Margolin, 2002, pp. 109–112). Echoing the critiques of Adorno and Horkheimer (2006),

Margolin observes that instrumental reason and technology (e.g. biotechnology) have a tendency to treat everything as an object with exchange-value (i.e. reification) and therefore reduce actual value. This leads to a lack of understanding of what can be lost in the process of creating the artificial and in many cases supplanting the natural (Margolin, 2002). He points to the dangers of replacing the natural with the artificial due to the inherent relations of production and power in the technological. The concentration of power in the artificial is therefore something that should concern designers (Margolin, 2002).

This mirrors Latour's whole premise about the potential for design to have a deep impact on how we navigate our ecological crises. Based on his analysis of networks and actants and on how relations of power are amassed and deployed, Latour champions design as a way of creating and of representing these assemblages. Likewise, Margolin doesn't seek to return to a pre-technological state but rather to redirect design practice such that we do not further submerge ourselves in simulacra. Margolin still wishes to maintain a separation of culture and nature—between that which is artificial and made by human design and that which is independent of design. For Margolin (2002), establishing that boundary is a necessary step in the survival of human society, as is moving away from attempting to completely replicate or supplant the natural with the artificial (p. 118). Yet this formulation is problematic because of the practical impossibility of drawing a boundary around what is and what is not designed or affected by design (i.e. human activity).

Part of this difficulty with the nature/artificial or nature/culture split is addressed through more recent work which describes how nonhumans mediate our relationship to the world. Latour—among others such as Sloterdijk (2005), Bennett (2010), Verbeek (2005), Fry (2009),

and Willis (2006)—reminds us of the agency of both humans and nonhumans (which include the objects created by humans in the framing of human action). The belief in a strict definition of nature versus culture has been problematized by, among others, Latour (1993b) and critiqued as one of the defining aspects of modernity—or non-modernity. Latour (1993b) suggests that this split has both allowed science and technology to produce ever more creations with little notice of the ramifications (i.e. environmental/ecological or social). Phenomena such as climate change are an acute example of this, for the pursuit of technological innovation has rendered a complex dynamic in which humans, culture, technology, science, and environmental actants are deeply interconnected.

Perhaps the most fundamentally artificial entity is the *thing*. Things are designed and as such emerge from an interaction of natural–cultural processes. As discussed above, it is also important to note that the term *thing*, for Latour, is a basic concept borrowed from Heidegger through the German etymology of *ding*, meaning a gathering and which highlights the process of becoming a thing (Latour, 2005a), and it is opposed to the notion of the object as a stabilized, unrelational entity. Following this framing of the term, things are therefore relational, processual, and constructed. Latour urges us to look at phenomena we tend to consider natural (i.e. matters of fact or objects) in artificial terms (i.e. matters of concern or things) so that we may see that design has played a central role in their creation and maintenance, and, more importantly, that we can critically judge it as being ill- or well-designed rather than true or false. Therefore an object like global warming becomes a construction much like a building or a chair or a thing that must be looked at in terms of the actants that it gathers as support—data, witnesses, images, spokespersons, governments, corporations, materials, workers, policy, capital, processes, etc.

At the root of the notion of artificiality is the requirement to dissolve the nature/culture split—a split that we have professed to have made in modernity (Latour, 1993b) but have really never achieved. This positions design, as a practice of the artificial, as a central discipline that sees beyond the nature/culture split and both deploys and represents nonhuman-human assemblages. This is an important aspect that highlights the connectedness of the social (i.e. human, cultural) sphere with the technological sphere. Humans control technology and technology mediates human interaction (e.g. mobile phone applications and social media). To this we add the use of the natural sphere as resource and context (e.g. coltan mining and conflict minerals). This entanglement results in the artificial—a condition in which no aspect of a human's everyday experience is untouched by social/technological intervention. Dilnot (2008), for instance, argues that design has now entered a new phase in which the artificial has risen to be the horizon and medium of our existence. This is beyond the notion of the artificial that was advocated by Simon (1988) in which it was a more discrete field that acted as the interface where humans could intervene between two environments governed by natural laws (the inner environment of the artifact and the outer environment) in order to produce a preferred situation (p. 68). Instead, artificiality represents an entanglement of different ecologies; matters of concern, in turn, represent the ways humans designate the reality of particular assemblages. This is something that Guattari (2008) had also observed, although his terminology focused more on three specific ecologies: mental, social, and environmental. These layers represent the individual, the collective, and the nonhuman as well as the inherent transversality between the layers. In the next chapter, through Latour's articulation and through Deleuze and Guattari's use, artificiality

will be discussed and will be shown to offer an opening to understand how cognition is supported and how subjectivity is produced.

Wicked Matters of Concern

If the artificial, as the space that emerges from the interaction of humans and nonhumans, is always already there for designers, it has not often been acknowledged. A prime example of this is the predominance of language which posits that design is concerned with *defining problems* and *creating solutions*. This amounts to a blind spot of designing that has allowed designers to ignore how their activity is framed and results in a *design as problem-solving* model. This linear model puts the problem "out there" and the designer "in here"—a privileged objective and critical position from which to view the problem and then solve it. Although the dominance of this model has perhaps lessened over the decades, it is still prevalent (Dorst, 2006) and espoused unreservedly by many designers (e.g. visual communication designers). The American Institute of Graphic Arts (AIGA), for instance, published a booklet that advocates for the role of design in the economy by outlining the design process as a linear development from problem definition to solution execution (2007). This dominant model in design is not addressed by Latour in his keynote. Instead, Latour frames the goals of design within the dichotomy of leap/rupture and iteration/repair. Despite this omission in his account of design we can apply some of the precepts of his methodology to problematize the problem-solution orthodoxy in design. This is a methodology that is implied in his keynote but which Latour has expanded considerably across other texts (Latour, 2005b).

Latour prefers the notion of design that operates as an additive process. His use of (re)styling as the central activity in design emphasizes the careful arrangement, configuration, and presentation of existing objects. This is consistent with his view that sociological methodology must pay close attention to the precise nature of the relations among actants as well as acknowledge that the research itself is a further description and deployment of existing accounts and actants in the network under investigation—the result is an ongoing process of piling on of carefully crafted descriptions. There is an emphasis on the belief that sociology—or design—is process without end in which components are added, removed, rearranged. By contrast, the problem-solution design model is predicated on a linear finite process that presupposes the existence of a clearly defined problem for which there exists an optimum solution. These are determinate problems (Buchanan, 1992, p. 15) that are cut off from their connections to other inputs. Latour's methodology privileges the connectors (the mediators of a network) and suggests that the cut-off mark is admittedly arbitrary (driven by limits of resources, time, attention) and does not represent a meaningful border to separate the significant from the insignificant (Latour, 2005b).

The conventional notion of problem definition is the description of all the elements of the problem and the requirements for a successful solution (Buchanan, 1992, p. 15). Objectivity, and therefore the possibility that the designer can define a real and stable problem, denies the possibility that the problem may be in flux, relative, or that its existence as a problem may be purely a construction of the problem-definer (e.g. the client or designer) who, in turn, has predefined the elements of the solution. This kind of objectivity is non-relational and relies on a process of purification or decontextualization which Latour (1993b) has identified as a basic

characteristic of modernist thinking—it presumes a perspective that is value-free and unencumbered by any material (i.e. nonhuman) effects. Although Latour has not cited Buchanan in any of his work, there is a strong alignment between their two approaches. They are linked by a shared thinking about the artificial and complexity in human-technological-environmental systems that is deeply skeptical of simplistic notions of technological progress and a nature/culture split. These concerns are represented in the twin notions of *wicked problems* and matters of concern.

The limitations of the problem-solution model have been identified before. It has been demonstrated that while this model may well be appealing for "tame" problems, it is most inadequate in the face of "wicked" ones (Rittel & Webber, 1973). Wicked problems are the white flag of surrender rather than the Promethean charge of revolutionary change identified by Latour. They represent an acceptance of the complexity, locality, contingency, and endless variation of any given problem situation. While tame problems are characterized by their strict causality, well-defined problem space, and established goals, wicked problems contain the opposite. As outlined by Rittel and Webber (1973), some of the key characteristics of wicked problems include: no definitive formulation of wicked problems; wicked problems don't stop; solutions are not true or false but good or bad; solutions cannot be definitively tested; wicked problems are symptoms of other problems; explanations of a wicked problem can be numerous; explanations of a wicked problem determine the solution; solutions are one-shot operations and can't be repeated exactly (pp. 161-166). This distinction between tame problems and wicked problems aligns very closely with the distinction Latour makes between matters of fact and matters of concern, respectively. This distinction lies in acknowledging the discursive, material,

performative, and technical aspects of all forms of knowledge, and the controversial nature of any object of knowledge given how these aspects frame and are framed by human and nonhuman activity.

The notion of matters of concern is highly consistent with Latour's early philosophy outlined in "Irreductions", the second half of his book *The Pasteurization of France* (Latour, 1993a). Harman (2009) posits that the central features of Latour's thinking entail the ontology of actants, the principle of irreduction, the process of translation and the nature of alliances. These concepts build on each other and all aim to describe how all things are composed through networks of other things that are found in a constant process of strengthening and weakening connections. The principle of irreduction, it is important to note, holds that no thing can be reduced to simpler components which fully explain the existence of that thing. Instead, all things are on the same ontological footing (Harman, 2009, p. 14) or pertain to a flat ontology (DeLanda, 2005). All things have agency and act as intermediators between other actants and therefore affect other actants. This leads to the understanding that things are in fact networks composed of human and nonhuman actants that are highly contingent, always transforming, and constantly negotiated. This, in turn, leaves matters of fact to be the exception and matters of concern the norm. And yet, the idea of matters of fact persists. As Latour states,

> If it is true as I have claimed that we have never been modern, and if it is true, as a consequence, that 'matters of fact' have now clearly become 'matters of concern,' then there is logic to the following observation: the typically modernist divide between materiality on the one hand and design on the other is slowly being dissolved away. The more objects are turned into things—that is, the more matters of facts are turned into

> matters of concern—the more they are rendered into objects of design through and through. (Latour, 2008a, p. 2)

Objects are no longer objects but rather projects that assemble heterogeneous actants and may only appear to be stabilized matters of fact.

Matters of fact, Latour (2004a) explains, have four key characteristics: they have clear boundaries where causality and truth are well understood; the means and labour by which an object is created becomes invisible; unexpected consequences of objects are relegated to a different sphere (e.g. social, political); and unexpected consequences of objects don't impact the original definition of the object (pp. 22–23). Much like tame problems, matters of fact are characterized by how ostensibly stable, definable, containable, and representable they are. On the other hand, wicked problems are akin to matters of concern in that they are full of conflicting values and points of view on a given situation. Nonetheless, they represent a shared site of concern. According to designer Peter Jones (2014), "Wicked problems include most persistent social and environmental issues, such as the continuous global problems that have evolved over time. 'Problems,' as we naively designate them, are essentially social agreements to name a salient concern shared within a culture" (p. 95). Wicked problems are artificial through and through. They frustrate any hope of a clear, logical, linear, causal relationship between one condition and another. As Jones (2014) reminds us, wicked problems have a social dimension that acts to designate a particular concern among a variety of people. It is in this way that wicked problems are similar to matters of concern.[14]

14 Matters of concern takes part of its meaning from the notion of public that emerges in a *public of the affected* elaborated by John Dewey. Dewey (1954) states that, "the public consists of all those who are affected by the indirect consequences of transactions to such an extent that it is deemed necessary to have those consequences systematically cared for" (p. 16).

Confronted with wicked problems or with matters of concern, design can be useful in devising necessarily limited and modest solutions or in describing incomplete and modest representations. Latour, in his keynote, implores designers to use the talents they often apply to representing matters of fact instead for representing matters of concern. Matters of fact are a product of *blackboxing* complex processes and stabilizing controversial issues in such a way that they are easily deployable and appear natural or commonplace. Design as a mode of representing (or visualizing) matters of concern would resist compressing and obscuring and would instead reveal the connectedness and reality of their construction.

Visualization as Designing for Matters of Concern

Presumably, Latour chose to focus on the field of design because it encompasses the creative activity of art, the productive activity of engineering and marketing, and the scholarly activity of academia. And as such it is well placed as a field that straddles the complex relationships between politics, industry, art, and philosophy to be the ground on which to investigate how we relate to our environment in terms of how we conceive it, intervene in it, and how it shapes us. Thinking about artificiality and criticality as key aspects of design helps us understand the way that design is social through the artifacts it produces, the way the artificial dominates our lived experience by illuminating and revealing, as well as how designers represent phenomena and negotiate difference and contingency.

Although this notion was formulated in an effort to establish a pragmatist political theory, its logic echoes that described in both matters of concern and wicked problems specifically in how a public emerges around the unexpected consequences inherent in wicked problems and which constitute a matter of concern.

A productive slippage occurs in Latour's keynote between design as *a way of making things* and design as *a way of representing things*. Despite his efforts to describe design as style of action informed by modesty and iteration, he ends his lecture with an urgent appeal to designers to visualize. He urges designers and design scholars at the conference to (visually) represent matters of concern, rather than simply design more artifacts. This is not a contradiction for Latour since for him the act of describing is also an act of intervention into the very networks being represented. Latour promotes the idea that the most promising role for design is that of description. He implores the designers and historians to build better visual languages for describing matters of concern such that we can facilitate better decision-making and planning, which are also both aspects of the general activity of designing.

Describing, representing, and visualizing have the capacity to open well-established norms or hot controversies to view by a public. This is the function of design that Latour prefers. Rather than only solve problems, design can expose problems to scrutiny by a wider diversity of stakeholders. Solutions can be ways of fixing things—in which fixing means alleviating a tension, removing an obstacle, or stabilizing a rogue element; this closely resembles the process of turning a matter of concern into a matter of fact. This is problematic precisely because matters of concern disappear from view once they are solved—solutions and matters of fact tend to *blackbox*. Latour (1999c) describes blackboxing as

> an expression from the sociology of science that refers to the way scientific and technical work is made invisible by its own success. When a machine runs efficiently, when a matter of fact is settled, one need focus only on its input and outputs and not on its internal

> complexity. Thus, paradoxically, the more science and technology succeed, the more opaque and obscure they become. (p. 304)

Design, in this regard, should be employed to reveal rather than disguise.

Therefore, one of the main roles for design is to address wicked problems by representing them as controversies or matters of concern. Latour argues that it is up to designers and artists to visualize and develop an aesthetics of matters of concern. Latour (2008b) points back to Otto Neurath's work on Isotype and the visualization of economics as an example of making facts visible for workers but stresses that what is needed now is a similar attempt that goes beyond logical positivism and Bauhaus modernism and which does not replicate the (visual) styles of matters of fact (p. 49). Latour (2008b) asks:

> How can a whole industry of visualization be wallowing in hype when we cannot even solve this simplest of all riddles: show me the people necessary to activate what you have drawn on a CAD design software. Soft indeed! Where are the artists, the designers, the programmers, who could finally extract us from the 17th century and bring us eventually to the 21st century? (p. 48)

To begin answering this question, Latour (2008b) provisionally outlines four basic specifications for the style of matters of concern: they must matter, be liked, be populated, and be durable (p. 47). In other words, for matters of concern to be adequately represented, designers must ensure that they: show how assemblages are constructed and connected to our experience; elaborate and invite further discussion; include the vast variety of participants in the assemblage; should be available to be inspected again and again. It should be noted that the potential of design to help in the representation of this complexity has been articulated by many of its main theorists and

practitioners. For instance, Archer (1979) reminds us that the essential language of design is modelling as a mode of representing (e.g. diagram, gesture, algorithm) a thing. Dilnot (1982) emphasizes the social and representational dimension of design that operates through cognition and communication. Although Archer and Dilnot align with Latour's position, Latour offers an analysis that shows how representations help maintain networks that are often reduced to social phenomena.

While these specifications are meant to redirect the representation of matters of concern, they are not meant as a guide to a pure mode of representation. Representation is not without its perils. Immutable mobiles—the term Latour uses to describe objects which can travel, hold their form, and be combined with other objects of representation—are so powerful they may replace the thing being described. As Latour (2008b) notes,

> once the operations of the mind are brought in, it is only a small step to confuse immutable mobiles as a solution for communications, with immutable mobiles as being what the world itself is made of. Matters of fact shift from being a descriptive mode, a style of reasoning, to what is furnishing the world itself. (p. 44)

Visualization must therefore acknowledge and even foster a sense of its own incompleteness and contingency. Latour warns that "if you stick to them, images are dangerous, blasphemous, idolatrous, but they are safe, innocent, indispensable if you learn how to jump from one image to the next" (2005a, p. 19). He expands this idea of jumping "from one image to the next" as a navigational model of representation—much like how navigators do with hazards in the ocean. There is a constant movement between the marker, the documented position of the hazard, the map and the moving position of the vessel (and the navigator) (Latour, 2005a). This is a reversal

of the mimetic model of representation where there is an expectation of a one-to-one correspondence between map and territory. Rather than have one visualization attempt to capture the fullness of a given phenomenon, Latour argues that one acknowledge the different tactics used and different representations referenced to determine one's relation to the territory. The navigational mode also reinforces a central argument regarding the act of design and wicked problems—that is a situated practice. To design representations or visualizations of complex assemblages or matters of concern necessarily requires a positionality that is manifested in the account itself. No god-trick of objective visuality need be applied in order to ensure complete representation. Instead, the designer should employ a plurality of "incomplete" accounts and a navigational process that builds a triangulated perspective on the terrain in question.

Why does Latour, in the end, make a plea for visualization and not other kinds of designing such as physical assembly and repair? Latour has devoted much effort to describing how scientific knowledge is created and maintained. One of the key processes he has documented is the *inscription* (Latour, 1986). The production and circulation of inscriptions (i.e. textual, visual records of information) amounts to a material, social, and cognitive means of extending the use of specific information across disciplines, establishing links between distant actors, and maintaining alliances between heterogeneous collectivities. The inscription is the basis of the scientific revolution, the industrial revolution, and continued technological innovation. It is therefore to this powerful technique that Latour urges us to direct our attention.

Another reason for Latour's plea for visualization is to be found in the notion of *explicitation*—a term he borrows from Peter Sloterdijk. Explicitation is the way in which our dependency on our environment is revealed. Latour (2008a) thinks of explicitation in terms of

design for it makes explicit the networks of associations between humans and nonhumans: "What I find so important in the notion of explicitation, of folding envelopes into envelopes, is that it is a powerful way of retrieving science and technology by completely modifying what is meant by a sustainable artificial life" (p. 9). Explicitating the artificial environments, networks, and spheres (i.e. envelopes) that we create in order to sustain ourselves, reasserts the nature of our vulnerability, embeddedness, and entanglement in these assemblages. Visualization is therefore a means of explicitation.

Conclusion

Latour has written elsewhere about the way that images, representations, cartography, and visualizations have helped build the edifices of matters of fact (1986, 1990, 2005b, 2008b). He takes these observations and applies them to the role of design and in doing so he resuscitates a quality of design that can help counter the hubris of the modernist mindset that is typified by, among other things, stabilized facts, a human and nonhuman split, definable problems, or elegant solutions. What is novel in his keynote is his direct appeal to design to understand its own capacity as a modest, additive, and configurational practice that can bring about a new aesthetics of matters of concern in the form of explicitation. This comprises a Latourian theory of design and it is logically consistent with the notion that we are entangled in a multiplicity of networks/assemblages. By merging core tenets of actant-network thinking with the practice of design, Latour has laid out the groundwork for elaborating more specifically on how visualization can act as a network or assemblage. What flows from a Latourian theory of design

is a process of visualization that draws things together, enlists participants, and looks after the way in which things are attached. In the following chapters I will discuss ways of supplementing these aspects by looking at the subjective and affective dimensions in networks through a deeper engagement with assemblages of enunciation. This will also lead to looking at criticality in design and applying it to the construction of networks and assemblages in order to understand the process by which decisions of quality (i.e. good or bad connections) are made.

Chapter Three: Subjectivation in the Visualization-Assemblage

Introduction

Visualization is a media practice which organizes everyday knowledges (e.g. entertainment, journalism, social media) as well as specialized fields of knowledge (e.g. science, economics, war). Visualization is an instance of the continuous mediation through which we live, navigate, and operate in our environment. It is part of the interface with which we perceive, think, and act. It is therefore necessary to find a framework that allows us to understand this one aspect of how we come to know about our environment and ourselves. Visualization, especially, has a particular grasp of the ostensibly objective reality that forms our surrounds, both local and remote, and, as such, can be a prosthesis to apprehend phenomena that go beyond our sensory apparatus (e.g. city-wide social patterns or movement and presence on the sea).

Visualization is also a process by which things are drawn together. In other words, people and objects are translated into a network that represents them. It is therefore important to see visualization as both a way of representing our attachments and a form of attachment itself. This entails bridging the way that visualizations affect the users with the way that visualizations assemble their constituent components. It requires making contiguous visualization's points of reception with its points of production. In order to do this, I will look at the ways that visualizations operate within networks and as assemblages. This will be done by discussing: the processes of bringing things and people together through Latour's concepts of immutable mobiles and inscriptions; the dominant tropes that frame visualization, such as objectivity, minimalism, transparency, and coherency; the cognitive processes that visualization augments;

the expressive and subjectivizing capacities of visualization; and the way visualization involves both representation and participation.

Before discussing these specific aspects of visualization we should address the question of why assemblages and networks have become the dominant framework through which to look at this practice. We can begin by noticing a common thread between the network and assemblage approaches, namely the problematization of basic dichotomies such as culture/nature, subject/object, and human/nonhuman. What propels this problematization is a particular interest in how an ecological crisis has emerged and how it can be survived. For Latour (1993b) this requires a critique of the modernist assumption of the split between culture and nature which has resulted in "monsters" (i.e. socio-technical networks) that bridge that divide and are therefore extremely difficult to manage or perceive. For Guattari (2008) (and Deleuze to a lesser extent) this involves an understanding of subjectivity as a nexus of mental, social, and environmental ecologies (p. 28).

To extend my use of Latour's framework, and what I've extracted as a Latourian design theory in the previous chapter, I will explore how we can think of networks and assemblages in the production of subjectivity—specifically, visualization's role in subjectification. Subjectification, or subjectivation, should be understood as the production of subjectivity through the entanglement in an assemblage. For this I am relying on Deleuze and Guattari's work and Maurizio Lazzarato's extension of their work on the production of subjectivity, assemblages of enunciation, and their theory of expression.

Assemblages and Networks

If we were to look for a common motif across artificiality and design, wicked design problems, and matters of concern, the image of the network or assemblage would emerge. Both denote an arrangement of associated (or attached) yet different nodes or objects. Design's role in matters of concern and in artificiality is to manifest the associations between human and nonhuman actors. These associations form networks of power that link social and technical processes with human, animal, environmental actors. Latour's keynote, discussed in the previous chapter, helps us understand the links between his actor-network theory (ANT) framework and the way that design assembles elements into powerful, recognizable forms. These forms can be, among other things, visualizations that are in themselves products of networks and actants within other networks. They can also be assemblages or components of an assemblage that produce affect.

While the terms *assemblage* and *network* are often used interchangeably, it is useful to note both how they are similar as well as how they are different—specifically, as I use them to refer to concepts advanced by Deleuze and Guattari, and Latour respectively. I use them in a complementary fashion in order to rely on the methodological components of an actor-network approach and extend the consideration of subjectivity through assemblage theory. This aligns with how other scholars have begun to think of this joined use of the approaches. For instance, Müller states, "one way to think of ANT is as an empirical sister-in-arms of the more philosophical assemblage thinking" (2015, p. 30). Where the former is interested in tracing the

shape of the network that binds us and others together, the latter is interested in mapping possibilities of connections.

The logic of network and assemblage which prioritizes how things relate is a central preoccupation in actor-network theory. As noted above, network thinking (i.e. ANT) is less theory and more methodology or approach to studying how humans and technological systems operate. The approach itself encompasses methods from sociology, anthropology, and ethnography. John Law (2009), a central figure in ANT, states that

> As a form, one of several, of material semiotics, it is better understood as a toolkit for telling interesting stories about, and interfering in, those relations. More profoundly, it is a sensibility to the messy practices of relationality and materiality of the world. (p. 1)

Assemblage thinking echoes the same premise and extends it to consider how subjectivity emerges:

> Assemblages may involve individuals, but also functions, machines, diverse semiotic systems. It is only by taking desiring machines all the way back to the molecular order—that is, to a point prior to the group and the individual [...]—that we will succeed in misarticulating mass-produced institutional structures, and in giving marginal positions of desire the possibility of freeing themselves from neurotic impasses. (Guattari, 1996, p. 154)

Thinking through assemblages allows for a way of going beyond individuals and locating the ways a variety of actants and processes can produce subjectivity.

The terms *network* and *assemblage* are used almost interchangeably by some flat ontology theorists (Bennett, 2010; Bryant, 2011) as well as by Latour (2005b), although for him the term

assemblage denotes more a collection of different objects. An essential feature of assemblages is the disregard for the difference between humans and nonhumans with regards to affect and agency. Similarly, Deleuze explains that for "the idea of assemblage, the nature-culture distinction no longer matters. […] But an assemblage is first and foremost what keeps very heterogeneous elements together: e.g. a sound, a gesture, a position, etc., both natural and artificial elements" (Deleuze, 2007, p. 179). Within an ontology of networks, this problematizes the *social* as a separable and meaningful concept since a society or collectivity would require the inclusion of nonhumans. For this reason, Latour urges us to not rely on social explanations (i.e. exclusively human agency) for understanding the organization of human life. He explains that the material and the technology with which humans live are an inseparable aspect of human action that must be accounted for in any description of society.

Assemblage also recalls the aesthetic dimension that was hinted at in Latour's use of styling and re-styling as arrangement or configuration of disparate components. The related terms assemblage, bricolage, and collage have long been strategies for modern art-making precisely because of the ways in which the final outcome does not resolve to either the parts or the whole but maintains that tension in order to highlight its own process of coming together. Different, often very incongruous, elements are brought together into a piece that maintains its integrity yet constantly signals its heterogeneity and the act of composition. The strategy normally involves the artist responding in a step-by-step manner to each addition made to the composition and often rejects any overall predetermined plan in organizing the work. Closely related to assemblage, the notion of bricolage also rejects the idea of a teleology governing the process of its composition. It is a privileging of the minor decisions made on the ground rather

than the creation and use of a plan. As Shelley Turkle and Seymour Papert (1992) explain with regards to designing computer programs, “Bricoleurs construct theories by arranging and rearranging, by negotiating and renegotiating with a set of well-known materials” (Bricolage section, para. 1). Furthermore, “Bricoleurs use a mastery of associations and interactions” (Turkle & Papert, 1992, Bricolage section, para. 4). In assembling, the plan becomes only a predisposition to follow the associations between disparate materials and not a predetermined image to which components must submit. This strategy is mirrored in Latour’s (2005b) comment that “The task of defining and ordering the social should be left to the actors themselves, not taken up by the analyst” (p. 23). In a similar vein, Law (2009) suggests that material semiotics is best understood as a “provisional assembly of productive, heterogeneous and [...] quite limited forms of ordering located in no larger overall order” (p. 5). The product and process of networking thinking (as methodology) is therefore to describe a relational heterogeneous network that follows the links created by the actors and not an a priori framework.

Assemblages, as well as networks, are also not static structures. Law (2004), quoting Verran and Turnbull, notes that an assemblage

> is like an episteme with technologies added but that connotes the ad hoc contingency of a collage in its capacity to embrace a wide variety of incompatible components. It also has the virtue of connoting active and evolving practices rather than a passive and static structure. (p. 41)

Assemblages are the opposite of fixed ensembles. They are processual. Assemblages are constantly changing, adding, and shedding components. Bennett (2010), for instance, describes the assemblage as an emergent and “open-ended collective” (p. 24). In contrast, the tendency of a

structural approach is to totalize the set of relations. While structures signal transcendent properties of how elements are related, assemblages and networks are provisional arrangements always on the edge of collapse. We can also see this in Guattari's notion of the *machine*, which represents the processual logic that can work in assemblages. It is categorically different from structure: "the machine will be conceived in opposition to structure, the latter being associated with a feeling of eternity and the former with an awareness of finitude, precariousness, destruction and death" (Guattari, 1995, p. 58). Both networks and assemblages differ from structures in that they emphasize the constant work required to maintain the arrangement.

The process of composing assemblages or networks can work to establish and maintain matters of concern. While Latour's network approach points to processes of mobilizing, translating, and enlisting actants into the network, Deleuze and Guattari's assemblage approach points to how assemblages create affects that impact a variety of bodies. Bennett (2010) notes that assemblages themselves also have agency and can exhibit a kind of life of their own or act as affective bodies. It is therefore not just the actants within a network or assemblage that have agency but the gathering itself that can affect others. As they are vital gatherings, assemblages are not static blocks of smaller components but instead ad hoc confederacies that persist despite the ebbs and flows of processes that work either for or against their existence. In a similar vein, Latour (2005b) suggests (like Thatcher but for different reasons, he reminds us) that there is no society but only collectivities, networks, associations, and assemblages in which decisions in matters of concern are won by whoever mobilizes the more powerful assemblage (p. 5). We can compare this to how Deleuze (2007) state that it is

> in assemblages [that] you find states of things, bodies, various combinations of bodies, hodgepodges; but you also find utterances, modes of expression, and whole regimes of signs. The relations between the two are pretty complex. For example, a society is defined not by productive forces and ideology, but by "hodgepodges" and "verdicts." (p. 176)

In other words, hodgepodges are the mixtures of actants in a network or assemblage, and verdicts are the matters of concern that are advocated. These compositions have agency, and, as Latour notes, they themselves become actants in other networks.

This leads to an important distinction between how the network and the assemblage describe the constitution of the actants or components in the arrangement. Within the network, all actants are effects of associations and are therefore only valid if they can be accounted for and traced.[15] It is the connections that are most important in the network. Law (2009) states that a network "assumes that nothing has reality or form outside the enactment of those relations" (p. 1). Within the assemblage, associations play a fundamental role in the existence of the arrangement, but components are not reduced to effects; instead they retain intrinsic qualities outside of any association (Müller, 2015, p. 31). As I will discuss later in this chapter, Deleuze and Guattari developed the notion of *forms of content* and *forms of expression* as one way of understanding this persistence and mutability.

The dominant characteristics of network thinking and assemblage thinking furnish a set of concepts that allow us to look at how visualization is a compositional process and has agency within other compositions. Each emphasizes a priority that is relevant to the current discussion.

15 This is a critique of the ANT notion of networks that has also been made from an object-oriented ontology perspective where the object or actant is not reducible to its connections to other objects (Harman, 2009).

In the case of Latour's network theory, the human-nonhuman associations and processes of maintaining those connections is of paramount importance. In the case of Deleuze and Guattari's assemblage theory, it is the human-nonhuman entanglements that produce subjectivity. Throughout the remainder of this chapter, I will discuss how these two approaches can be combined to investigate how visualizations are produced and circulate, how they act as interfaces, and how participants are incorporated.

Networks and Visualization

Visualization has an incredible power to represent, enable, and persuade. Part of visualization's power is derived from how it operates as an object and a process. It is an object in the sense that it can have a physical existence that can be described and sensed by multiple people and that can be compared to other such objects. But it is also a process—much in the same way that John Pickles (2004) insists that maps are in fact *mapping.* It is a process insofar as there are flows of data that become visually represented that are, in turn, recontextualized, redrawn, recombined, and circulated through a variety of media. Latour's (2005b) network concepts help us understand this ontology of the visualization as an object and process. We can follow up this analysis with Latour's own meditation on diagrams, maps, and charts which, he notes, can form *cascades of inscriptions* that promote, reduce, and clarify scientific statements or which can also act as *immutable mobiles* that allow accounts to travel long distances and thus extend our sensory/perceptual reach. Of equal importance, Latour holds that in order for this kind

of work to be done by visualizations, they need to operate within processes of knowledge representation and political processes that enlist allies and denounce opponents.

Power is accrued through the network of visualizations. Objects such as immutable mobiles and inscriptions encapsulate human action and extend it beyond human capacity. Visualizations are tools for observing people, things, and events in space but are also design tools for planning, coordinating, and controlling them in space. Governments, research labs, think tanks, and corporations use these techniques in the fulfillment of their respective agendas and consequently as bodies producing knowledges that project an authoritative view of the world. Visualization power stems from its use by authorities in society as well as from the very process by which it reduces complexity and ambiguity into something graspable and presents in visible form something previously invisible. This has been the case since at least the golden age of cartography (Alpers, 1987).

For instance, we can look at Latour's analysis of maps to understand how they require a context of other maps in order to become authoritative. Latour (2010) suggests that maps, as well as scientific visualizations, function as part of a cascade of inscriptions. The cascade is the increasing sophistication of image production that summarizes other images (or data sets) and reduces data to salient points to present a clearer and more powerful argument. The inscription draws its power through its connection to other inscriptions—for if any inscription, or visualization, were to be taken out of its context and disconnected from its body of precedents, it would become a purely aesthetic object, losing its ability to communicate meaningful information and thus losing its scientific value. The drawing together of allied data into the visualization increases the power of the inscription. This is reinforced due to the fact that the cost

of re-producing the image from scratch becomes a deterrent and hence the value of the inscription is raised. Data, whether it is in the form of other inscriptions or in the very costly collection of empirical data from the source, is brought together in one central site or inscription (Latour, 1986). This has the effect that

> the cost of dissenting increases with each new collection, each new labelling, each new redrawing. This is especially true if the phenomena we are asked to believe are invisible to the naked eye; quasars, chromosomes, brain peptides, leptons, gross national products, classes, coast lines are never seen but through the "clothed" eye of inscription devices. (Latour, 1986, p. 17)

The "clothed eye" is in fact an increasingly complex apparatus that is not easily replicated. It is also constituted by an individual's or organization's ability to access the required technology, materials, processes, and specialized knowledge.

The piling up of inscriptions is a layering and processing of information that is also dependent on the compatibility of data—the ability to compare data on common terms. Scientists' ability to map and visualize a variety of data over and over again is predicated on this standardization of data. In other words, if things are made to work on the same code they are infinitely comparable, recombinable, searchable, etc. Latour (2010) states that *metrology*—the science of standardizing measurement—is fundamental to the creation of visualizations. This agreement to treat a variety of quantities in compatible ways allows for people, agencies, governing bodies, academic bodies, or corporate bodies to act, as Latour terms it, as *centres of calculation*, exerting power via the knowledge they produce through the combination and

layering of mass amounts of data and, consequently, large amounts of connections to people, places, processes, and things.

Overlaying and mapping are two of the most powerful ways of creating connections between different sets of data. Overlaying involves taking one set of points and imposing it on another set.[16] It effectively takes one thing out of one context and places it into another. The proportion (or relation) between the numbers stays the same but the scales change—essentially a unit conversion. Mapping is also, of course, the overlaying of numbers, text, contours, dots, or areas onto an image that has an indexical relationship to physical space. In terms of visualization Manovich (2002) states that:

> By representing all data using the same numerical code, computers make it easy to map one representation into another: grayscale image into 3D surface, a sound wave into an image (think of visualizers in music players such as iTunes), and so on. Visualization then can be thought of as a particular subset of mapping in which a data set is mapped into an image. (n.p.)

The space onto which data is mapped is always a rationalized space. It is necessarily a Cartesian space measurable in discrete units along an x, y, or z axis that allows for the computation of data points. Similar to the mapping of numbers, this kind of mapping gains enormous power in the compression and standardization of diverse sets of data.

16 In computer programming this is a common function that is used very frequently to make one set of numbers understandable as another set. For instance, the set {0, 1, 2, 3} based on a range of 0 to 10 can be mapped onto a range of 0 to 1 {0.0, 0.1, 0.2, 0.3} or onto a range of 128 to 516 {128.0, 166.8, 205.6, 244.4}.

Visualizations garner power through the use of several strategies that rely on communicating indexicality, clarity, rigour, proof, connections, coherence and logic. Some of these aspects are recalled through simply referring to the data visualization genre. Others are evoked through the very process of visualization that simplifies, smoothes, erases and emphasizes data to create a seemingly complete picture. Visualizations depend on networks of actants and processes that create coherence which adds to its power to represent objective knowledge. David Harvey, for instance, notes that maps promote an orderly view of reality. He states that cartography engages in

> locating, identifying and bounding phenomena and thereby situating events, processes and things within a coherent spatial frame. It imposes spatial order on phenomena. In its contemporary manifestation, it depends heavily on a Cartesian logic in which *res extensa* are presumed to be quite separate from the realms of mind and thought and capable of full depiction within some set of coordinates (a grid or graticule). (Harvey quoted in Pickles, 2004, p. 81)

In other words, the assumption is that objective knowledge of the external world can be quantified and spatially ordered because it is observable. The observable—the organic and disordered patterns of seeing—are in turn systematized and stabilized through visualization techniques such as the grid. The graticule (i.e. grid) used in mapping provides a systematic way of consistently presenting objects in a stable and calculable space. The aim of this technique is to present an inspectable vision of space. It is a technique that is "concerned with how we know the world and how what constitutes 'public knowledge' can be represented in ways that all can

understand" (Pickles, 2004, p. 86). Again, placing multiple data sets within a rational, ordered space aids in the presumption of objective knowledge.

While the power of a visualization lies in the way it is connected to other inscriptions and the way it incorporates standardized data, it also depends on the removal of any evidence of its construction. Paradoxically, where the data comes from and the process by which it was arranged needs to be obscured. Pickles, for instance, explains how a map makes a "representational claim [that] was always predicated on making the many specific decisions, compromises, adjustments, generalizations, and slippages that characterize all knowledge production disappear. That is, it erases the work the map actually does" (Pickles, 2006, p. 349). It is therefore through erasure or a process of *purification* that the idea of truth is communicated. The sketches, mistakes and possibilities for alternative configurations would otherwise undermine a visualization's tendency to appear as a given and its ability to show one authoritative narrative. The rough pencil marks on the paper have been rubbed out and the dust brushed off to make the final diagram presentable and absolute. Purification in this sense, attempts to separate the natural dimension from the cultural dimension—the real from the interpretive. This is kind of separation Latour describes as the epitome of modern knowledge production that removes any hint of the implication of politics and ideology in the construction of our view of the natural world (and vice versa) (Latour, 1993b).

Within the field of cartography we also see this tendency. Pickles, for instance, suggests that the search for a practice that focused on science, accuracy and truth intensified in response to the increased use of propaganda maps during the First World War (Pickles, 2004, p. 41). This meant that the persuasive and manipulative characteristics of maps were demoted to a set of

political artifacts that must be avoided. Ironically, it is the move towards a more scientific form of representation that attempts to eschew political and cultural overtones or specificities that ultimately makes the visualization form more persuasive.

As a result, the visualization's status as an assemblage or network becomes more difficult to discern. The process of erasing traces of its production naturalizes its claims. The ways that it marshals other inscriptions and incorporates other traces make the data appear more cohesive and produce a more believable picture. As Pickles (2004) notes, "the map was a construction that always drew upon disparate information sources, patched together mappings from a variety of sources, built upon cartographic techniques and taken-for-granted practices, and thus contained within it traces of these legacies" (p. 88). Similarly, Henri Lefebvre (1991) notes that the persuasiveness of representations of space relies on how they tend to make everything coherent (p. 313). This is especially problematic given that the process of making a visualization necessarily creates incoherencies. Ingrid Kallick-Wakker (1994), for instance, describes the process of visualization as comprising three steps—identification, quantification, and categorization—that are instrumental in the organization of empirical data but that inevitably create gaps and incompleteness (p. 310). This data set is, in turn, restored to a sense of coherence through visualization. All these traces of production are smoothed out to create a seamless whole onto a rational, Euclidean grid. Moreover, cartographers have historically interpolated between the data points to fill in the void, therefore maintaining the appearance of a one-to-one relationship between data and the phenomenon. By smoothing the erratic data the cartographer (and visualizer) fashions a more beautiful shape of the information and therefore helps present a more persuasive and definitive picture of reality. All these processes and techniques work

towards making the artifact a powerful representation of reality. The more sophisticated and automated these techniques become, the more these processes themselves are blackboxed and elude critical inspection.

Purified Objects and Immediacy

Blackboxing removes the network of associations and the processes from scrutiny. The conditions that produce the blackbox are standardized procedures, conventions, and masses of inscriptions allied so that they support the fundamental claims being made. In visualization, blackboxing has often had an aesthetic dimension that supports its naturalization. Minimalism, transparency, and coherence all contribute to a sensation of seeing something objectively rendered. The promise of objectivity in research and communication was particularly attractive in the early 1900s (Daston & Galison, 1992). This aspiration can be seen, for example, in the use of visual form to communicate objectively—an approach greatly enhanced by the work of various members of the Vienna Circle during this period. In particular, Rudolf Carnap's work on intersubjective and neutral languages to describe mathematical, logical, or scientific concepts, and Otto Neurath's work on communicating sociological and economic information in universally accessible ways, advanced the notion that an objective form of representation could be developed and used to improve human understanding.[17]

17 A key premise here is the association of objectivity with intersubjectivity—where a set of shared subjective perceptions of a given phenomenon constitute sufficient grounds for validating the existence of a thing. Daston and Galison note that Carnap was instrumental in putting forward this kind of intersubjective approach to communicating thought. It relied on eliminating particulars and revealing only the relational and structural character of a concept. This ensured that multiple theorists and researchers could access the concept (Daston & Galison, 1992, 291). This suggests that a highly formalized visual representation can serve to share knowledge amongst individuals.

Although visual design has taken many forms and followed many styles over the past century, within the domain of visualization design has inherited a very strong ethos of minimalism that supports a pervasive ambition to represent data objectively. We see the application of a modernist and minimalist aesthetic to goals of scientific rigour and universality in the collaborative work of Otto Neurath and Gerd Arntz—specifically, the Vienna Method of Picture Statistics (later renamed ISOTYPE for International System of Typographic Picture Education) (Cat, 2014) that aimed to communicate sociological and economic information to as wide an audience as possible. The visual language of this *visual education* work was a perfect marriage of the logical positivism of the Vienna Circle and Gestalt-like aesthetics. The aesthetic visual language mirrored the pursuit of general laws that were ostensibly independent of history, culture, and politics—a growing concern of Neurath and the Vienna Circle in the interwar years in Europe.

Neurath's graphics work through icons that refer to people, machines, territories. But visualization styles often attempt to present indexical links to the phenomenal itself, thus promoting an assumption that there is a direct link between the representation and data. As Pickles (2004) notes, cartographers have assumed that mapping was a *mirror of nature* (p. 36). This term is strikingly similar to William Henry Fox Talbot's (1844) notion of the *pencil of nature* that frames photography as a photogenic drawing that lets nature and light do the work of recording its existence, therefore rendering its fidelity only a matter of technical perfection. Likewise, objectivity, notes Pickles, was derived through the proximity of the mapper (and map) to the reality of nature. In data visualization, this assumption of indexicality is ingrained and naturalized even more so. There is a virtually unquestioned direct relationship between a pixel, a

variable, a data source, and tool of measurement. Richard Wright (2008), in his entry on "data visualization" in *Software Studies: A Lexicon*, notes that information visualization has inherited the notion of expressiveness from Edward Tufte (p. 79). Expressiveness relies on the ostensibly self-evident nature of data and our need to *let the data speak for itself*. This, in turn, emphasizes the objective claim that can be made through referring and presenting things in themselves—this is analogous to stating that *nature has spoken*. Again, this echoes Latour's 2008b own recognition of the value of Neurath's project but with the caveat that rather than repeat the style of a naive positivism it must reveal matters of concern in a way that acknowledges its own constructedness, invites discussion, reveals its constituent parts, and is available to repeated inspection (p. 49).

Purifying cartography (and visualization more generally) from any traces of mediation disconnects it from its social context of production and reasserts the illusion of being objective and rational—a critique levelled by Latour (1993b) towards modern knowledge production in science and sociology. It assumes that visualizing can transcend the messy political, social, and cultural turbulence of any particular historical period. In doing so, a map or visualization becomes what Haraway terms a *fetish*, which is an object that acts as a substitute for the real thing. Haraway (1997) states that "the maps are fetishes insofar as they enable a specific kind of mistake that turns process into non-tropic, real, literal things inside containers" (p. 136). In other words, maps give the illusion of presenting the thing-in-itself and eliminating any marks that alert the viewer to the practices behind its production. Making a map look non-tropic, non-fetishistic, and ensuring that it looks clear and rational and a product of a scientific non-culture is the *god trick*. Haraway (1997) suggests that this ostensibly non-tropic ideal form of map serves

up a space enclosing various entities and "readying them for further exploration, specification, sale, contract, protection, management, or whatever" (p. 136). Therefore the map is rendered just a tool and can be critiqued only for how it gets employed but not for the inherent biases that it reproduces.

Making the tool appear more neutral involves a series of choices and processes which attempts to correct any misreadings while attesting to the tool's accuracy. As Wood (2010) explains,

> It's not just pragmatism or objectivity that dresses the topographic map with reliability diagrams and magnetic error diagrams and multiple referencing grids, or the thematic map with the trappings of f-scaled symbols and psychometrically divided grays. It's the urge to claim the map as a scientific instrument and accrue to it all the mute credibility and faith that this demands. (p. 106)

Our reception of a sketchy map, for instance, would contrast that of a pristine, technically drawn map regardless of the claims being made. As cartographer J.K. Wright (1942) warns,

> The trim, precise and clean-cut appearance that a well drawn map presents lends it an air of scientific authenticity that may or may not be deserved. A map may be like a person who talks clearly and convincingly on a subject of which his knowledge is imperfect. (quoted in Board, 2011, p. 45)

The visual tropes of objectivity are thus upheld in the name of efficiency and immediacy.

In order to make itself *disappear* and presumably allow the content to be read efficiently, the aesthetic dimension of information visualization has generally tended towards this minimalist style that reduces all forms to their essential parts—the visuals are reduced to forms that follow

function.[18] Minimalism, an aesthetic movement associated with early modernist artistic European movements including Russian Constructivism, De Stijl, and the Bauhaus, began with a general concern for the reduction of form to geometric and/or abstract shapes. The aims of this movement were to explore the relationship between the fundamental properties of human visual apparatus and aesthetics, to communicate across linguistic or cultural differences, and to achieve a sensory response from a viewer with a minimal form. The aims of minimalism overlap significantly with the research of the Gestalt school of psychology (i.e. Max Wertheimer, Wolfgang Köhler, Kurt Koffka) during the same period. For instance, one of the main contributions by the Gestalt school is its early work focused on visual perception and the articulation of principles of visual perception known as the *Law of Pragnanz* which states that every stimulus is perceived in its simplest form.

The minimalist impulse is still dominant today; driven by a desire to communicate efficiently, it is also aided by the representation of communication as a linear exchange of signals between two nodes that can be hindered by noise in the channel. For instance, the prominent information visualization writer Edward Tufte (2001) has promoted the concept of a *data-ink-ratio* to highlight the principle of *less is more* where the minimal amount of visual stimuli (in the form of ink) should produce the maximum amount of meaning. Pickles suggests these mathematical models of communication that emphasize a linear process where a message is transmitted between a sender and receiver (such as those developed by Shannon and Weaver [1964]) have heavily influenced the way cartography has been taught and studied. In fact, Board

18 This phrase articulates a design philosophy, associated with architect Louis Sullivan and rooted in the Bauhaus tradition, that emphasized a beauty born out of authenticity, utility, and economy.

(2011) outlines how during the mid-20th century there was a concerted effort to research cartography as a form of communication and as such attempt to model the use of maps as a communication process. Board's *map-communication-model* describes the information flow from a map maker to a map user. The implication of this model is that the flow can be quantified, "noise" reduced, and correspondence evaluated.

Reducing noise, standardizing interpretation or decoding, and easing communication are still dominant goals in information visualization and this has led to a focus on the cognitive supports in visualization and the pursuit of an *immediacy* of pattern recognition. The apparent preference for an objectivist, mechanical, and minimalist aesthetic is also born out of a desire to reduce cognitive load. The avenue to reducing work in deciphering representations is understanding the way human brains perceive and process visual stimuli along with providing all available resources for completing a specific cognitive task. Card (1999) identifies this as a "cost structure of information" (p. 14). The goal is immediacy—literally meaning no mediation or at least reducing the costs of mediation.

Simplification, reduction, and non-contradiction work hand-in-hand with the aims of the field of information visualization to augment cognition. It is through this simplification that patterns can be detected and the shape of the data can be discerned using the human visual system's built-in pattern-finding mechanisms. The processes of visualization—the "knowledge crystallization" process; the data aggregating, filtering, and parsing process; and the visual encoding process—all involve a steady narrowing of possible interpretations of the data in order to flesh out salient features that produce patterns (Card, 1999, p. 10). Reduction is precisely the process that turns raw data into data tables which are turned into visualizations (Card, 1999, p.

11). This is, in other words, the distilling of data material to essences which ostensibly produce a truer picture of the reality that is inside the raw data. This mirrors a conception of cognitive processing:

> There appears to be a general Principle of Selective Omission of Information at work in all biological information processing systems. The sensory organs simplify and organize their inputs, supplying the higher processing centres with aggregated forms of information which, to a considerable extent, predetermine the patterned structures that the higher centres can detect. The higher centres in their turn reduce the quantity of information which will be processed at later stages by further organization of the partly processed information into more abstract and universal forms. (Resnikof quoted in Card, 1999, p. 11)

And as Card (1999) states, "information visualization simply abets this process of producing patterns that can be detected and abstracted" (p. 11). Visualization thus attempts to remove noise or contradiction from the raw data such that salient features become more prominent. This is concomitant with the endeavour of scientific knowledge which "encompasses nature by representing nature; it represents nature as visualizable or as presentable in a non-contradictory complete form, as if it could be mapped into a space of finite dimensions" (Figlio, 1996, p. 74). Augmenting cognition, with visualization, involves creating sensory experiences that map onto human cognitive capacities in such a way as to minimize effort—this in turn makes a more powerful impression that rings truer.

To reduce costs—both cognitive and financial—perception and cognition of visualizations have been understood as *sensory* and *arbitrary* (Ware, 2013). Colin Ware, researcher in information visualization and perception psychology, suggests that these two main ways in

which representations function are part of every visualization. The sensory and arbitrary distinction falls roughly along the lines of physiological and cultural-linguistic differences in understanding visual representations, respectively. On the one hand, sensory representations have the following properties: sensory immediacy, understandability without training, resistance to alternate denotation, and cross-cultural validity (Ware, 2013, p. 12). On the other hand, the properties of arbitrary representations are that they are: hard to learn, easy to forget, embedded in culture and applications, and formally powerful (Ware, 2013, p. 15). The work involved in arbitrary representations is based on learning conventions and their associated meanings as well as maintaining this knowledge. This is arduous by comparison to sensory representations which are read retinally. In other words, this process depends on a *sensory immediacy* by which Ware (2013) means the work that *pre-attentive perception* performs in the human visual system. Sensory representations work best in the user task of pattern recognition. For instance, if a set of variables in a data set are of similar value then our *pre-attentive perception* activates to recognize a grouping of proximate points on a chart visualization. What is important to understand is the fact that this process occurs before the user understands exactly what these points represent (a secondary phase that involves more elaborate processing). The user simply recognizes *group*. The recognition occurs without conscious thought. It is therefore understandable that *immediate* or instant recognition of a pattern is highly convincing since it relies on a physiological process before it relies on a cognitive process. This is reminiscent of the ability of sensory images, specifically photography and film, to affect us (i.e. pre-attentively) in profound ways—a phenomenon that was also registered by Walter Benjamin. Benjamin (1968) describes the effects of architecture and film acting upon us by way of *distraction* and *tactile appropriation*. It is

through habit formation (not active contemplation) that a building (or artifact) affects "the masses." The masses may come to a specific kind of understanding of this artifact but, as he states, "the public is an examiner, but an absent-minded one" (Benjamin, 1968, p. 241). This is a two-fold opportunity: for a greater distribution of the sensory experiences to the masses and for a more powerful mechanism for shaping public consciousness.

The *tactile appropriation* that Benjamin uses to understand the capacity of moving images is almost a kind of embodied apprehension. This type of apprehension depends on an unwitting acceptance of basic features. If we use Ware's (2013) notion of sensory representation we can see the real persuasive power of these features (p. 12). These are a set of properties which outline the universalizing and naturalizing tendencies of visualizations (which are, as mentioned above, understandability without training, resistance to alternate denotation, sensory immediacy, and cross-cultural validity). In particular, Ware suggests that sensory representations are resistant to alternate denotation. This makes criticality of visualization that much more difficult. As Ware (2013) states, "the problem [in data visualization] is that once data is represented as a visual object, it attains a kind of literal concrete quality that makes the viewer think it is accurate" (p. 28). The concreteness, physicality, and immediacy conform to a tactile appropriation—as if the real thing was before our very eyes.

These are the processes in the network that contribute to the creation of visualizations. But these visualizations don't simply exist in a network, they do work themselves. Part of this work is subjectivization; another part is the process of engendering tropes of coherence, objectivity, and transparency, and therefore a picture of reality. Such visualizations work on a pre-attentive,

tactile, sensory level which operates within assemblages that involve both physical and semiotic components.

Subjectivation and Visualization

The "literal concrete quality" that Ware describes can play a role in our subjectivation. It is here that assemblage thinking can help us understand the articulation between human and nonhuman in the production of subjectivity. Assemblages of enunciation are networks that work through semiotic components. Lazzarato (2014), paraphrasing Guattari, explains that expression as a collective semiotic machine is in fact "a collective assemblage of enunciation encompassing diverse and heterogeneous substances of human and nonhuman expression" (p. 65). This concept did not start with Guattari for we can see the genealogy of the concept of enunciation at least as far back as Foucault (2002), who outlines the role of enunciation as an operative function within a field of discourse (p. 99).

Latour (2005b) acknowledges that Foucault's later work that deals with subjectification offers a promise for understanding subjectivity beyond the notion of interiority or psychology: "make every single entity populating the former inside come from the outside not as a negative constraint 'limiting subjectivity,' but as a positive offer of subjectivation" (p. 212). Latour notes this understanding of subjectivation (or subjectification) as a process that springs from the *equipment* we use—equipment being Foucault's notion of a medium through which we construct subjectivity. With respect to the processes involved in visualizations, Latour again advances a constructionist approach that puts the work in a network and not in a mysterious interiority. As

he states, “cognitive abilities do not reside in ‘you’ but are distributed throughout the formatted setting, which is not only made of localizers but also of many competence-building propositions, of many small intellectual technologies” (Latour, 2005b, p. 211). For Latour, a recourse to subjectivity also brings in tow the notion of objectivity and thus resurrects the modernist dichotomy of nature and culture.

What Deleuze and Guattari (and Lazzarato) offer is a Latour-compatible conception of subjectivity. It is a subjectivity that highlights the role of being entangled in an assemblage. It is less concerned with interiority and more concerned with the cognitive, aesthetic, and affective realm that works similarly to Latour’s (2005b) *plug-ins* that build our competences to navigate, use, discern, participate, etc., but that also act in proto-enunciative ways that we are not completely aware of (p. 204). While Latour dismisses the role of the cognitive or the affective in favour of the more traceable processes of objects, Deleuze and Guattari’s (assemblages of) subjectivation involves a non-linear dimension that cannot be captured.

Assemblages of enunciation, insofar as they are arrangements of experiences, messages, codes, environments, objects, humans, etc., are involved in the formation of subjectivity. Lazzarato (2014), for instance, emphasizes that this is a machine that works to produce subjectivity, and states that “intelligence, affects, sensations, cognition, memory, and physical force are now components whose synthesis no longer lies in the person but in the assemblage or process (corporations, media, public services, education, etc.)” (p. 27). A visualization is one such assemblage that is expressive and effects viewers or users in subtle yet powerful ways. This can be used to add to Latour’s concepts of immutable mobiles or cascades of inscriptions. Rather

than rely on the material semiotics in Latour's network thinking, Lazzarato, through the work of Deleuze and Guattari, alerts us to role of *a-signifying semiotics*.

Diagrams, according to Lazzarato, work through an a-signifying semiotics. They do not work as *images* that are symbolic and representational. Instead,

> diagrams, curves, and data "speak," "express" themselves, and "communicate," for, by making visible, comparable, and manipulable the most diverse flows of information (machinic translatability), they forcefully contribute to decision-making and price-setting. Diagrams provide the thresholds of proto-subjectivity from which human subjectivity determines its choices. With each threshold it crosses to make a decision, to express an evaluation, and to indicate a price, subjectivity has no choice but to rely on machines, a-signifying writing systems, and information codified and produced by mathematical instruments. (Lazzarato, 2014, p. 97)

Here Lazzarato is specifically interested in understanding the mechanisms and processes involved in the sustaining of capitalism. Where critiques of representation, for him, have failed to adequately elucidate the power of capitalism, Lazzarato looks to the underside of representation to explain its ability to endure. But rather than replace a critique of representation, Lazzarato, similar to Latour, looks to supplement it with an analysis of the effects of nonhuman agency. Lazzarato (2014) points out that

> "Objects," machines, protocols, diagrams, graphs, and software lose their "objectivity" and become capable of constituting vectors of "proto-subjectivation" or focal points of "proto-enunciation." That machines, objects (and signs), do so means that they suggest,

> enable, solicit, prompt, encourage, and prohibit certain actions, thoughts, and affects or promote others. (p. 30)

Lazzarato includes the way objects, processes of visualization, and software play an important role in sustaining capitalism through subjectivization.

Stock market traders and their entanglement within (visualization) assemblages are useful figures in seeing how subjectivity can be produced. Lazzarato (2014) describes the interface that surrounds a trader (i.e. graphs, diagrams, numbers) as the "indispensable components of enunciation, of 'nonhuman' sites of partial subjectivation" (p. 97). According to Lazzarato, these signs no longer simply represent a remote reality but become the things themselves that are transformed and which transform reality. They are operational on the world, through the user and on the user. The trader therefore forms part of an assemblage where "mathematical systems, data banks, interconnected computer networks, telephone networks, and so on, are part of the financier's subjectivity" (Lazzarato, 2014, p. 99). This echoes how Guattari (2008) put diagrams into a techno-scientific semiotic category amongst other mechanisms or instruments that support capitalism (p. 48).

We can find resonance between Lazzarato's development of proto-subjectivation and visual design—one that specifically speaks to fundamental cognitive and perceptual principles built into the practice of visualization. There is a useful resonance between *proto-subjectivities* and the notion of *pre-attentive cognition* which forms a fundamental pillar in the design of visualizations. Pre-attentive cognition draws heavily on the work of Gestalt psychology and the research done in perception and cognitive science. Akin to pre-attentive perception (discussed above), it is a kind of retinal processing that works at a stage that precedes actual cognitive

processes that infer meaning, access memory, etc. (Ware, 2013). Although proto-subjectivity refers to a variety of experiences of an affective dimension, it is useful to note that this does include the visual sensory apparatus. With this in mind we can approximate the ways that pre-attentive cognition may work as a kind of affect. As noted earlier, visualization holds a particular grasp on our cognitive processes by the way our sensory apparatus reacts to visual stimuli. To recap, this *retinal processing* performs a basic operation which contributes to deeper cognitive work where meaning is derived. But these visual components do offer a basic semantic structure (as described in Gestalt principles of psychology) that conveys notions such as grouping, continuance, common fate, similarity, connection, etc. It is this immediacy in processing information that lends to the "literal concrete quality" that Ware attributes to visualizations. The difference between the sensory and arbitrary components of visualization noted by Ware can be mapped to the a-signifying and signifying components of assemblages of enunciation.

This connection between cognition, subjectivity, objects, networks, and assemblages finds allies in the work of other scholars working in literary theory, computation, and design. There is an emerging body of scholarship that attempts to link the affective dimension, the cognitive dimension, and the design of visuals and environments. For instance, Johanna Drucker (2014) also notes that visualizations and the graphic codes deployed in visual design create interfaces that mediate human subjectivity. But rather than hold on to the affirmative, instrumentalist, and mechanistic notion of user-experience that is often the focus of the human-computer interaction (HCI), Drucker insists that we adopt a critical theory of interface born out of media theory and graphic design. N. Katherine Hayles (2014), on the other hand, acknowledges the importance of considering something similar to the proto-linguistic but in terms of cognitive nonconscious in

order to supplement the analysis offered by critique and interpretation. Hayles notes that one of the processes at work within the cognitive nonconscious is the constitution of the *protoself*, a concept developed by Antonio Damasio. It is in this pre-conscious phase of experience that humans begin to form consciousness. Not unlike Guattari's (and Lazzarato's) proto-subjectivation process, the cognitive nonconscious as well as the protoself are specific sites where capitalism is reproduced. In a similar vein, Parisi and Goodman (2011) posit a compatible analysis to the cognitive nonconscious and the protoself with what they term *mnemonic control* as a component in affective capitalism. Their account is focused on the embodied memory that is formed, triggered, and oriented towards the future through an immersion in branded spaces.

These theoretical frameworks, along with the present study, are parallel attempts to describe the mechanisms by which signs, in the form of media images, visualizations, interfaces, places, and devices, suffuse consciousness and nonconsciousness above and beyond linguistic or representational components. With this analysis in hand, it is easier to notice the ways that visualization functions as a process of entanglement within systems that may empower or disempower by increasing or decreasing our ability to understand and act.

Visualizations also have the power to frame our relationship to the world precisely because of our experience of the world. Information visualization borrows authority through the reciprocal exchange between what Lefebvre (1991) terms *representations of space* and *representational spaces*. As an example, Lefebvre describes how the labyrinth is at once a spatial concept and a spatial experience. What we now know as a labyrinth has historically oscillated between being a spatial strategy for trapping enemies, a model for building palaces, a representation of the womb, a metaphor for life's journey, or a space for amusement. In other

words, the labyrinth (both historically and currently) informs the spaces we build and experience as well as informs the metaphors we use to explain aspects of life (Lefebvre, 1991, p. 233).

Lefebvre's description of the emergence of perspective drawing makes an even more concrete link between the visualization of space and how physical space is experienced. He observes that "These artists 'discovered' perspective and developed the theory of it because a space in perspective lay before them, because such a space had already been produced" (Lefebvre, 1991, p. 79). This is a reciprocal movement that produces representations of space through social practices (e.g. the use of cypress trees to delineate property along borders) but also reinforces and re-articulates representational spaces which in turn show up in representations of space.

The reciprocal socio-cultural relationship observed by Lefebvre is supported by more recent research in cognitive science. Barbara Tversky (2011) suggests that our mental representations and how we perceive our visual representations are shaped by the way we operate in the physical world, what she terms *spractions* or spatial-action representations. These are not elaborate meanings that are conveyed but rather building blocks of meaning, e.g. group, type, proximity, etc. They also operate "silently and directly" (Tversky, 2011, p. 528). It is through our physiologically-based familiarity with embodied knowledge and its invisibility that visualizations (especially diagrams) gain their effectiveness. When Tversky (2011) subsequently states that "the designed world is a diagram" she makes clear that the exchange between lived physical (i.e. representational) space and virtual (i.e. representations of) space is reciprocal (p. 528).

Visualizations, in particular maps, have had a long history of being able to reproduce the territory along a preferred concept of that territory. They do this in two ways: first, by preparing the ground. As Denis Wood (2003) notes, "Cartographers [and the academic field of map making and theorizing] played a significant role in making the world safe for colonizers, mining conglomerates, and the military" (p. 7). Second, maps present an ideal version of a territory that spatially arranges power according to class and to which residents adhere. Angel Rama (1996), for instance, notes that colonial cities in New Spain typically used concentrically arranged urban space that put the seat of power (e.g. vice-royalty) at the centre, surrounded by the *lettered* bureaucratic class, and then descending classes towards the periphery; these arrangements were literally drawn up (i.e. mapped) in the centre of the Spanish Empire then communicated and implemented in the colony.

The centre as a visual signifier of power is well understood (Arnheim, 1988). Thomas Saarinen (1987) provided empirical evidence to support this point in his study of 3,863 geography students from 49 countries on various continents who were asked to freehand draw the shape of continents/countries. Saarinen observed that an overwhelming proportion of students drew their world map with Europe in the centre. Students who did not fit this trend were largely from mainland China. Saarinen speculates that students from locations that appear on the edges of a Eurocentric map prefer Sinocentric maps. The striking exception to this tendency was from students in Hong Kong who preferred to draw Eurocentric maps—presumably a result of conditioning in a colonial educational context. These conventions become second nature and efforts to unlearn them become arduous. For example, as Tversky (2011) notes, "Even though arbitrary, the conventional north-up orientation of maps has both cognitive and practical

consequences; north-up maps are easier for many judgments" (p. 507). In other words, these images and others are ingrained and become tools for navigating and judging our immediate reality.

Size is another visual signifier of power and its representation in maps became a very well-known controversy that pitted scientific cartographers against social humanitarian cartographers, objectivity versus ideology, and first world versus third world (Crampton, 1994; Monmonier, 1995). This controversy was so heated and so important that Crampton (1994) called it "cartography's defining moment" due to the fact that it marked a point when the issues of power and knowledge came into direct contact with issues of technical precision and scientific realism.

The controversy began with a technical problem of map projection—how to represent the surface of a sphere (i.e. Earth) on a flat surface (i.e. a map). This technical problem found solutions in various projections (e.g. Mercator, Robinson, dymaxion) that inherently included compromises that distorted or omitted aspects of the spherical surface. Arno Peters (quoted in Crampton, 1994), a German historian, observed that the ubiquitous Mercator map used in education around the world increased the size of landmasses in the northern hemisphere (i.e. European countries) which in turn reduced the relative size of the southern hemisphere (i.e. African, South Asian, and South American countries); he thus claimed that it was a map that "overvalue[d] the white man and distort[ed] the picture of the world to the advantage of the colonial masters of the time" (n.p.). Peters promoted his own map projection (called the Gall-Peters projection) that corrected this representation. While the map projection promoted by Arno Peters had specific technical problems, its main objective lay outside of (scientific) cartography and instead in the larger societal context that included concerns of power (Crampton, 1994). This

is reflected in the fact that the map has been distributed widely by UNESCO and several other NGOs with mandates to address poverty in the developing world. The Gall-Peters map is therefore offered as a corrective to a Eurocentric conception of space that too easily aligns with and abets other asymmetrical power relations embedded in cultural imperialism, language, and trade. These educational maps are an example of how representations (e.g. geographical, sociological, scientific, political) can be part of networks that mobilize knowledge and inform. But they do this not only at the level of information that can be accepted or rejected but at the level of assemblages that produce subjectivity.

Assemblages contain physical components as well as expressive components. The productive process of an assemblage can be seen, for example, in Guattari's description of his experience of watching television. A "production of polyphonic subjectivity" emerges when he is attracted to the luminous glow of the screen, when he is absorbed by the narrative of the program, and when his daydreams float by (Guattari, 1995, p. 16). Partial subjectivity, for Guattari (1995), involves the pre-personal, polyphonic, collective, and machinic (p. 21). Deleuze and Guattari (2004) describe assemblages in the following terms:

> On a first, horizontal, axis, an assemblage comprises two segments, one of content, the other of expression. On the one hand it is a machinic assemblage of bodies, of actions and passions, an intermingling of bodies reacting to one another; on the other hand, it is a collective assemblage of enunciation, of acts and statements, of incorporeal transformations attributed to bodies. Then on a vertical axis, the assemblage has both territorial sides, or reterritorialized sides, which stabilize it, and cutting edges of deterritorialization, which carry it away. (p. 97)

The machinic assemblage is comprised of *forms of content* that interact with assemblages of enunciation that are comprised of *forms of expression*. The machinic assemblage works in conjunction with the assemblage of enunciation—these two notions roughly correspond to the physical object world and the world of language, respectively (Young, 2013). We are thus situated within assemblages where the material components that physically aid our bodies to move and sustain themselves (i.e. machinic) and the semiotic/performative components that aid our understanding of our environment (i.e. enunciative) both interact. The relationship between content and expression lies in the idea that both can have a form. The form of content and form of expression are independent yet related entities. For example, where content can be a person, expression can be a particular designation of that person. A person in a court can be designated as guilty and as a felon. The person (i.e. content) is also a felon (i.e. expression). The advantage of this model is that the same content can undergo different *incorporeal transformations* and thus have different expressions in different assemblages—in a court assemblage, that person is a felon, in a family assemblage, that person can be a sibling.

Expressions are more than linguistic or symbolic components—they are performed. The illocutionary power of stating someone's guilt or innocence demonstrates how expressions, as spoken and signifying terms, can have an impact. But leaving it in the linguistic and symbolic field would limit the usefulness of this model. It is precisely in looking at the non-linguistic and nonhuman ways that expression functions that makes this concept useful. Guattari (and Deleuze to lesser extent) develops the notion of a-signifying semiotics in order to account for the non-linguistic, and more affective and aesthetic forms of expression in an assemblage. For Guattari, a-signifying components work as proto-subjective components that operate prior to a notion of

the individual. They constitute the array of nonhuman forces that come to bear on the production of subjectivity. Similarly, Bryant (2014), who advances a model of *incorporeal machines* based on Deleuze and Guattari's model, notes that these are assemblages that work to form human subjectivity through training, habits, norms, environments, etc.

Conclusion

Visualization practice involves both representing our attachments and producing attachments. This is most evident in the way a visualization can show, for instance, the gentrification of a neighbourhood through the placement of markers on a map, as well as the way the same visualization enlists participants to share their data to make the map and how the map itself is taken up, repurposed, and circulated online. Through the visualization process a-signifying components are at play in the perception of the visual representation as well as in the gathering of data, participation at events, visiting of locations, and sharing of content.

The equipment Latour (2005b) refers to as part of subjectivation is also the "material and intellectual technologies" that are used to observe, record, study, and evaluate (p. 197). This equipment is also a form of attachment, or, in other words, our attachments are equipment that we use (and that use us) to live, perceive, etc. As discussed in the previous chapter, Latour highlights the importance of thinking through attachment (referencing Sloterdijk's development of the concept). This is reiterated when he states that emancipation "does not mean 'freed from bonds' but well-attached" (Latour, 2005b, p. 218). Within the terms of design, this is tantamount to the artificial—the ecological composition of human and nonhuman actants. Visualization, as a

design practice, produces various assemblages through which we perceive our world. In similar terms, Stengers (2008) reminds us that artificiality is the equipment in the assemblage that helps us approach something beyond us (e.g. nature, other) (p. 52). This is an assemblage that works through artifacts, processes, and affect: "To tell about a force, or to feel it, to be affected by it, always means that an assemblage has been produced, or fabricated—a matter of art, or artificiality, never a testimony of wild authenticity" (Stengers, 2008, p. 43). Design, especially in the form of visualization, is therefore involved in creating the style of our attachment, the kind of equipment we use, and the conditions of our artificiality. Design governs how we are attached and visualization provides a specific form of equipment with which we inspect our attachments.

We must critically assess the way we are attached. As Latour (2008a) suggests, the designer must assume a modest role that aims to repair and restyle our forms of artificiality and attachment. This implies that criticality is concerned with statements of quality and not necessarily negation. He suggests that "the question to be addressed is not whether we should be free or bound but whether we are well or poorly bound" (Latour, 1999a, p. 22). Similarly, Stengers (2008) advocates for an engagement with discrimination (instead of critique) in which the quality of associations are attended to.[19] This is of great importance given the way that assemblages of enunciation are sites of partial subjectivation. They work on a proto-subjective level in which pre-attentive cognitive processes take place. Criticality, in this respect, takes place

19 A critical understanding of attachment in digital creative practice is not new and is echoed by Sean Cubitt's (2007) outline of the precepts of digital art. From the perspective of form of practice, Cubitt describes a set of conditions that should be met by any artistic practice that involves new media. These conditions share an overriding concern for connectivity, process, mediation, and participation. Cubitt shifts the meaning of interaction, as in the feedback loop between computer and operator, to something more akin to attachment—precisely because labour is required for a digital art to become activated. He advocates for a form of digital indexicality where the artwork itself signals its position within a larger socio-technical network or assemblage (Cubitt, 2007, p. 307).

through discriminating the quality of the equipment that furnish our subjectivation. What is also important to note is that this equipment and this assemblage is deployed beyond the artifact of the visualization. It can take the form of performances, sites, derivations of a visualization into other forms, news reports, etc. To flesh this out in the following chapters I've looked at the work of the Forensic Architecture, *Anti-Eviction Mapping Project*, and my own research-creation project—all of which engage participants in manifold ways, all derived from visualization.

Chapter Four: Two Cases

Introduction

On March 27, 2011 a boat carrying 72 African refugees ran out of fuel. It was on a journey between Tripoli, Libya and the Italian island of Lampedusa. During the next 14 days nearly all the passengers died while NATO ships and fishing boats observed the drifting vessel.

Over the past decade thousands of families have been evicted from dwellings in downtown San Francisco to make room for investment properties that serve tech-company employees. These families—predominantly poor, immigrant, and racialized—continue to be displaced in order to fuel the officially endorsed creative economy.

These two incidents are examples of a wider ongoing phenomenon in which sectors of society are both made invisible and discarded because of a paradoxical combination of their status as a perceived threat to economic or societal stability as well as their vulnerability and alterity. Part of what allows for this dynamic to continue is the relative invisibility of the processes that either exacerbate risks, displace families, or obfuscate accountability.

Liquid Traces is a visualization documentary that makes the case for NATO accountability in the death of the African refugees. The *Anti-Eviction Mapping Project* is a collection of visualizations and events that advocate for housing rights for tenants in San Francisco's Bay Area. I've selected two projects that aim to visualize these two issues, respectively. They were chosen because they employ different modes of visualization that highlight the importance of paying attention to the networks and assemblages involved in collection, creation, presentation, and dissemination. These aspects are especially important when considering projects that seek to

advocate for social justice and produce counter-hegemonic messaging. These are projects where respect for participants, accurate representation, and continued engagement are embedded in their mandate. For this reason, I will be analyzing these projects through the framework of network and assemblage as applied to visualization that I developed in the previous chapter. This chapter will endeavour to apply Latour's design theory to the problem of visualizations "in the wild," that is, visualizations that are considered beyond the confines of mere artifact and that interact and mutate in a wide ecology of objects as well as specifically attempt to elucidate matters of concern. I propose that Latourian terms offer a way of thinking through the practices of visualization but that a more supple framework is needed in order to account for the ways that visualizations affect users and how they are performed, distributed, and remade. In order to accomplish this, I will use this extended framework (described in earlier chapters) that looks to the notion of expression and assemblages of enunciation to better analyze the ways that a visualization circulates and mutates, and how a visualization affects and attaches human participants.

Latour's notion of design as a practice that deals with artificiality and matters of concern through *explicitation,* with an ethos of modesty and attachment, gives us a framework with which to consider how visualization, as an instance of power and participation, is deployed in a variety of practices. Latour's framework works well in describing how a visualization is constructed and how it fits into a network. *Liquid Traces* is a very suitable project to explore this. However, there are some inherent limitations with Latour's framework with regards to how subjectivity is considered. This dimension is important to consider because it highlights an untraceable process (hence Latour's dismissal), but it is nevertheless a speculative or theorizable

process that is often underrepresented. This will be explored with aspects of the *Liquid Traces* project but will be expanded more fully with the *Anti-Eviction Mapping Project*. For this Deleuze and Guattari's (and Lazzarato's) notions of affect, expression, and assemblages of enunciation will be applied in an effort to supplement Latour's framework. The bridging of these approaches is undertaken in order to create a conceptual model that can be applied broadly to any number of visualizations, or, more precisely, any number of visualization practices that are committed to a critical engagement with their own processes.

Liquid Traces

Liquid Traces is a project created by Charles Heller and Lorenzo Pezzani, both doctoral candidates at Goldsmiths University in London, under the auspices of Forensic Architecture. Headed by Eyal Weizman, Forensic Architecture is a research group based at Goldsmiths that aims to use the abilities of designers and artists in collaboration with journalists, scientists, sociologists, and activists to unearth evidence that is embedded in open data, citizen journalism, social media, etc. and assemble it in coherent ways that can be used as proof in courts of law and in popular media.

The *Liquid Traces* project combines the elements of documentary and visualization (including cartography and dashboard) into a video that compellingly presents the case of the so-called "left-to-die boat." The project also comprises a report, *Forensic Oceanography: Report on the 'Left-To-Die Boat'* written by Heller, Pezzani, and collaborators at Situ Studio.[20] The

20 Video and documentation can be accessed at: http://www.forensic-architecture.org/case/left-die-boat/.

documentary/visualization includes images and video from the research, analysis, and process work involved in creating the visualizations. It brings together many elements that corroborate in the telling of the story, including segments from interviews, documents, maps, diagrams, and timelines (see Figure 1).

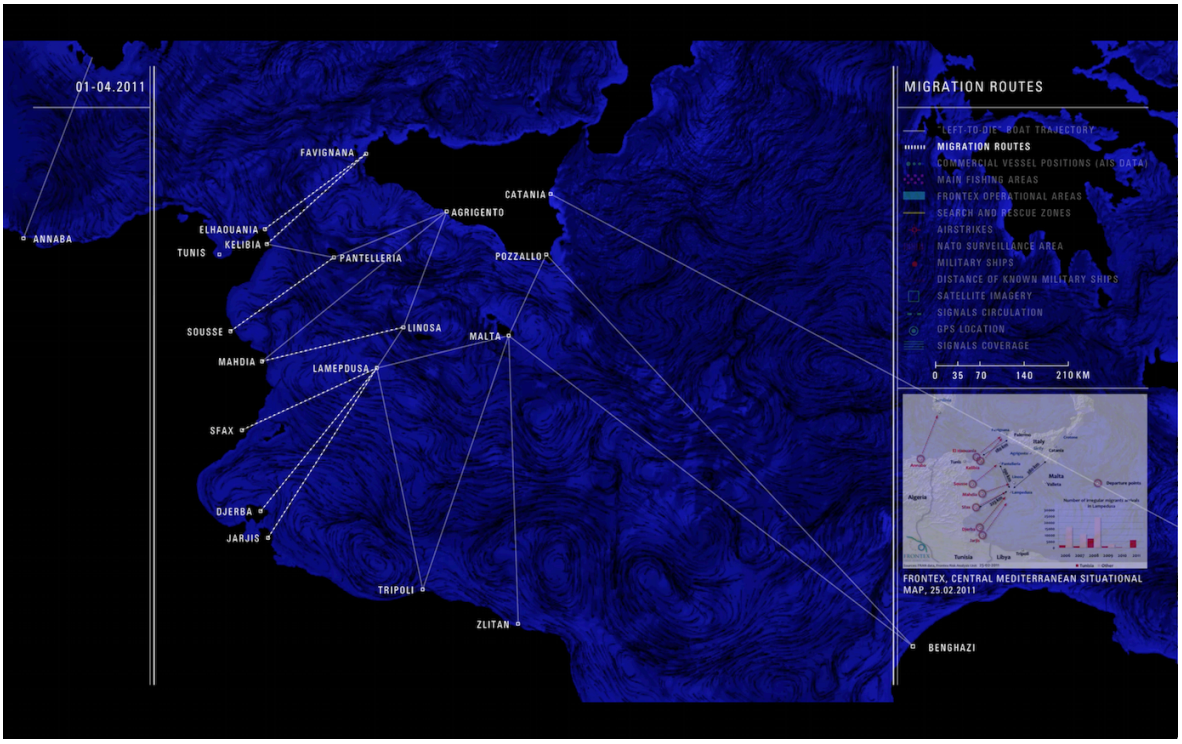

Figure 1. Visualization dashboard video (screen capture). From "Liquid Traces" by Heller and Pezzani (2014).

What make this project an important case study for understanding how critical visualization practice should be seen as a network/assemblage is how it brings things together, how it affects participants, and how it travels. A matter of concern is revealed through this network and the style of its construction is made apparent, including the enlisting, affecting, and attachment of human participants. *Liquid Traces* is a visualization project that presents an

interface that simulates a tool for visually inspecting data. This involves processes of assembling people, technologies, sources, and other evidence that provides and affects the user/viewer with complex and rich layers of information and imagery. This also involves the process of creating an aesthetic experience that weaves these elements together such that it is both authoritative and compelling. Ultimately, what is at stake is a matter of concern regarding the visibility of refugee lives within a dominant culture and political structure that often upholds systemic racism and prefers to ignore the consequences of a colonial history and a continued interventionist mandate in former colonies. The project specifically details the human cost of European immigration policy as applied in the Mediterranean Sea, the site of continued migration from poor or war-torn African countries to rich European countries. Pezzani and Heller note that 1,200 other deaths of people crossing the Mediterranean Sea from Libya to Europe were documented during the same year of the "left-to-die boat" incident. In addition, 14,000 deaths have been documented at the border of the EU in the past 20 years, and an even greater number is estimated for undocumented deaths. It is within this context that the "left-to-die boat" incident occurred in which over 60 refugees, including men, women, and children, from Libya died in their attempt to reach the European territory of Lampedusa. The crux of this injustice lies in the non-assistance by vessels, including NATO military vessels, that came into contact with the boat. The *Liquid Traces* project therefore is aimed at supporting legal cases filed by NGOs in Italy, France, Canada, Spain, Belgium, and the UK against the states whose military operated in the area during that time.

Dashboard and Platforms of Calculation

Latour's (1986) description of the processes and effects of assembling heterogeneous sources (i.e. inscriptions) in such a way that one is better able to compare, contrast, recombine, and synthesize (p. 11) offers a useful lens to look at projects that draw together a multitude of sources in order to present a compelling narrative. In addition, Latour's further work on how inscriptions can be thought through a navigational mode rather than a representational mode offers a powerful tool for considering the ways in which such projects may be used or read to form a fuller picture of a given issue or phenomenon. Forensic Architecture's *Liquid Traces* project exemplifies both of these aspects through its creation of a visualization interface and a surface on which multiple sources are collected and sequenced.

The *Liquid Traces* project demonstrates the increasing difficultly of distinguishing between different genres of visualization. While there are specializations such as data visualization, scientific visualization, medical visualization, architectural visualization, geographic visualization, information visualization, info graphics, and visual analytics (amongst others), it is often the case that a visualization will involve a number of these genres in one project. In an effort to triangulate around a particular point of interest, different data sources and thus different visualization genres may be deployed in order to more fully represent the issue. For example, a visualization showing sales volume (both historical and projected) for a consumer goods company may involve conventional charts showing volume of sales over a given period of time but it may also show a geographic distribution of sales. These visualizations, in turn, may be incorporated into a *dashboard* that attempts to give the user an overview of the general health of

the company, or it may be incorporated into a slide presentation which offers a narrative of the company's performance to a roomful of investors.

The dashboard is a recent convention developed in visualization which itself mimics the instrument panel in an airplane cockpit, boat, or vehicle. The instruments are positioned so that the pilot, skipper, or driver may at-a-glance pick up on critical indicators and compare different metrics, all in the process of making decisions and taking action. Through inclement weather and treacherous terrain or where visibility is limited and not trustworthy, the dashboard provides a rationalized layout of precise measurements of various aspects needed to navigate safely. The aesthetic is thus one of control over a chaotic external world. The dashboard renders this messy exterior as a regulated, measured, and rationalized view from the safety of a protected interior.

The *Liquid Traces* visualization mimics a dashboard in both its simulation of the liveliness of a real world and the interactivity afforded by this kind of interface. Yet this visualization is a video, not an interactive tool, and as such it follows a linear path in order to tell a concise, compelling, and angering story about the negligence of NATO countries towards North African refugees attempting to reach Southern Europe. Through the course of the video, the viewer witnesses the events taking place while the dashboard remembers, predicts, categorizes, and contextualizes these events for the benefit of the viewer. Dashboards, in the form employed by the video, are an assemblage of a variety of sources that work similarly to the way *inscriptions* and *immutable mobiles* do, as described by Latour. He develops the concept of the immutable mobile to explain the way scientific knowledge has been built up and how it has attained more power than traditional knowledges—a process which began with the advent of maps and achieved full momentum with the printing press. If inscriptions, as they move from one context

to another, retain their basic form and content and are not easily modified, they become powerful links to past observations, recordings, and interpretations, and help build a view of the world. Their mobility and reproducibility are essential to the spreading of knowledge. They are recombinable with other inscriptions, for instance as overlays. They depend on a form of optical consistency that allows them to be compared to other inscriptions. They also greatly assist the written text in establishing points of reference and a cohesion between narrative and visual evidence (Latour, 1986, p. 18).

These last two properties of immutable mobiles are perhaps the most powerful. Their two-dimensionality allows them to become part of geometry and therefore they can be calculated and merged with other inscriptions. They also merge with texts to form an object in which "the text and spectacle of the world end up having the same character" (Latour, 1986, p. 20). Pezzani and Heller employ both these properties to maximum effect in their video. Firstly, throughout the video they add a voice narration which acts as the text that often accompanies inscriptions. This presents a self-evident display of data wherein the voice describes and the images on the screen corroborate. Secondly, the authors divide up the screen space into quadrants dedicated to particular types of data. This juxtaposes various elements without occluding other important elements already on the main screen space. This space is a map with a graticule (i.e. grid) representing latitude and longitude, which allows an extensive array of data to be combined, superimposed, and thus compared. What results is a surface that orchestrates inscriptions and augments cognition, and, in this sense, gains the authority that maps have traditionally accrued. As Latour (2010) notes, "maps have always been platforms of calculation interface" (p. 582).

Assembling the Allied Inscriptions

The narration is the textual layer that requires the visualization for its proof. Much like reading a text, the video's forward movement locks the viewer into following the explicit logic of the narration as it builds on argument after argument that will lead to an impactful conclusion. Each piece of evidence is displayed on screen and described through the narrative. Michael Lynch (1988) (borrowing from Morrison) notes that this is an effect in scientific illustrations as well: "the illustration is an autonomous surface that is nonetheless contained within a text, and which can be used in various ways by the text's discourse to invite a reader to 'see what is being said'" (p. 203). This works similarly to how the narration in *Liquid Traces* is essential to understanding the claims being made. The narration utters an assertion, as if anticipating the action in the video, and the visualization confirms what is claimed. This is one of the underlying powers of visualization when deployed in multiple media—the claims being made are presented as self-evident.

This interplay between text and image in visualizations has been used as a prop for displays of expertise. Visualizations, Latour (1986) suggests, are essential for supporting claims made by scientists. Latour notes that "When these resources were lacking, the self same scientists stuttered, hesitated, and talked nonsense, and displayed every kind of political or cultural bias" (p. 4). The aura of objectivity, expertise, and authority is produced with the aid of these and other visual presentation materials. This can occur through other components and processes in the assemblage. For instance, Pezzani's act of gesturing during the press conference with International Federation for Human Rights can be compared to how the narration in *Liquid*

Traces directs the viewer's attention to the salient and convincing details of the visualization. Pezzani gestures to the maps and visualizations produced for the case of the left-to-die boat (see Figure 2) to present the evidence that supports his claims. Despite becoming an expert on the case through the process of researching the incident and consequently earning a Ph.D. based on the project, Pezzani uses the visualization to make explicit the terms, relations, and significance of what he is stating for the reporters and videographers.

Figure 2. Lorenzo Pezzani at press conference June 18, 2013. From Pezzani, Heller and Situ Research (2014).

Charles Goodwin (2001) expands on this performative dimension of images and interaction to indicate that when speech and gesture is involved it is often used to direct attention (p. 164).

Goodwin shows that images are used with speech and gesture to direct a listener's attention and to supplement the image itself. This constitutes a complex performance between objects and humans wherein all actants are interlinked. The image itself is not simply a representation of a real thing but instead a useful representation for the speaker to bolster parts of his testimony. Pezzani's presentation of the map at the FIDH press conference with Abu Kurke, a survivor from the refugee boat, exemplifies the interactive dimension between image, speech, and gesture.

The use of text is also used to confirm the animations taking place on the map. For instance, we can see how the top-right side of the dashboard contains a list of datasources that foreshadow their inclusion in the case being narrated (see Figure 3). The list of labels includes: left-to-die boat trajectory, migration routes, commercial vessel positions (AIS Data), main fishing areas, FRONTEX operation areas, search and rescue zones, airstrikes, NATO surveillance area, military ships, distance of known military ships, satellite imagery, signals circulation, GPS location, and signals coverage. The labels light up when the respective datasource is being visualized and overlaid on the map. It acts as both a table of contents and pile of evidence to assure the viewer that the case being made is supported by numerous but allied inscriptions (i.e. data).

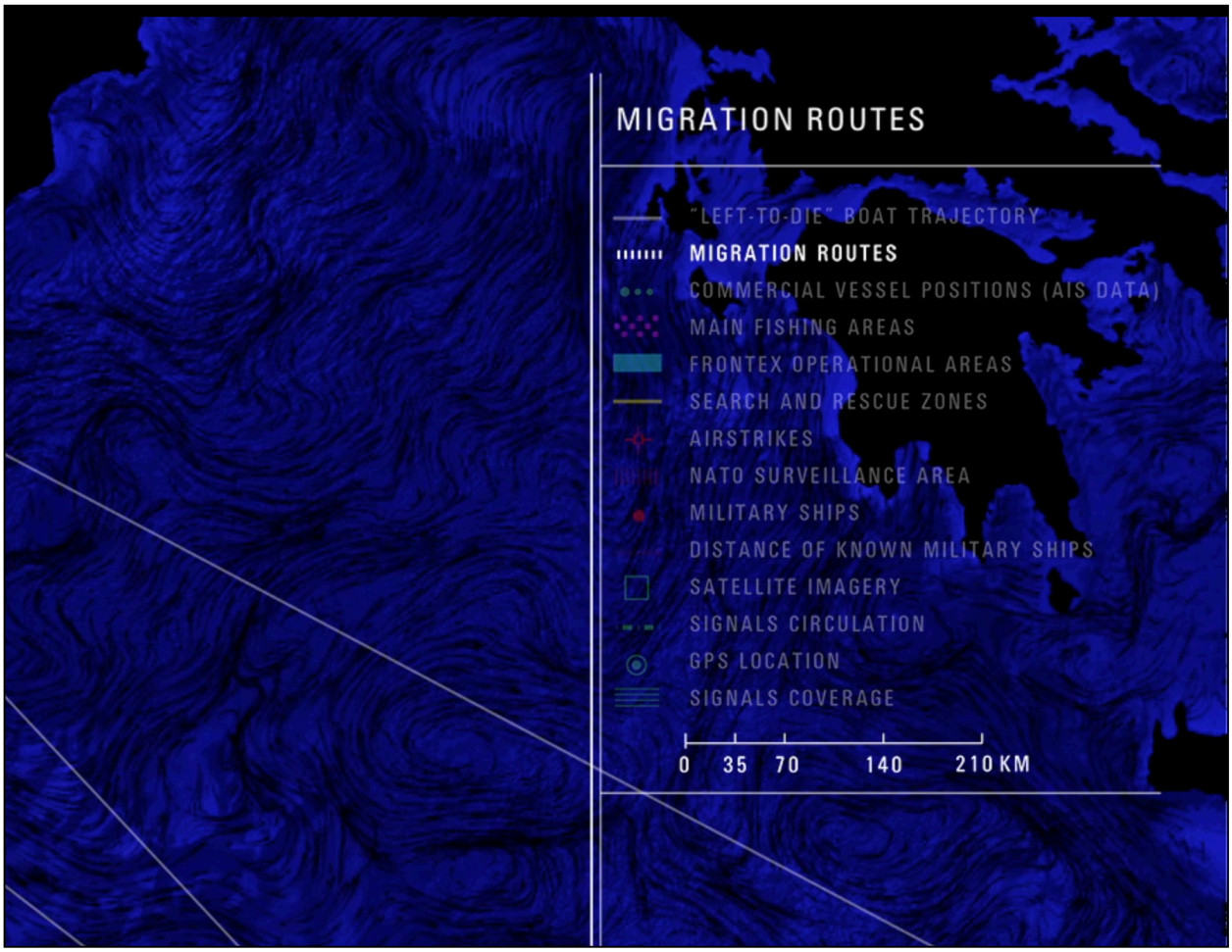

Figure 3. Visualization dashboard showing list of data sources (screen capture, detail, top right corner). From "Liquid Traces" by Heller and Pezzani (2014).

The bottom-right side of the dashboard (see Figure 4) is used occasionally to show small clips of news videos that corroborate the narrator's account of events leading up to the case in question. News reports as well as amateur video of protests in Benghazi, Libya coinciding with the 2011 uprisings in multiple Arab countries, often referred to as Arab Spring, are played in this section. These are followed by thumbnail views of maps from the U.S. Department of Defence showing NATO attacks on Libya that were ostensibly to support resistance to Ghadafi and to

prevent the loss of human lives. Most importantly, the middle section is reserved for the annotated map. It shows the NATO surveillance area that was established during the airstrike campaign against Ghadafi's regime. This area overlaps with the trajectory of the refugee boat and points to the coalition forces' non-assistance of the vessel in distress.

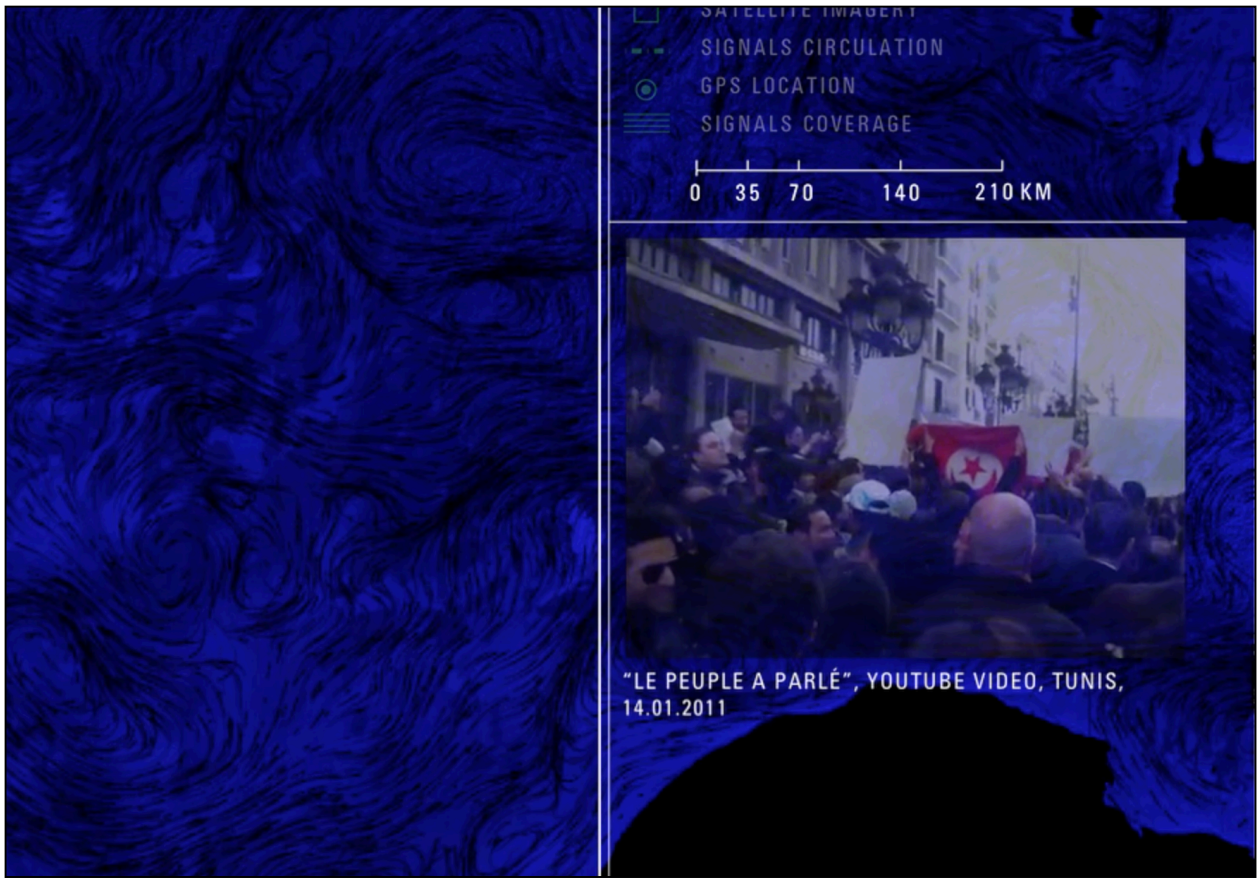

Figure 4. Visualization dashboard showing news video clips (screen capture, detail, bottom right corner). From "Liquid Traces" by Heller and Pezzani (2014).

To build the case, the video does not attempt to rely on one definitive view. Instead, the dashboard assembles its allies in the attempt to reconstruct the event from multiple points of view. We are alerted to this additive process by the overlaying of photographic and radar satellite

imagery on top of the diagrammatic overlays of vessel positions and the refugee boat trajectory on the map. Satellite imagery is a form of evidence that is at once indexical yet opaque. It offers a snapshot of light patterns or in some cases echoes received by radar. Although sensors on some of the satellites (e.g. RADARSAT-1) can resolve up to eight metres, determining the identity of the vessels detected in the image is a process of establishing probabilities—these are listed on the bottom-right with their respective levels of confidence (e.g. 95%, 90%, 85%).

This additive technique is common in scientific research and other fields; it attempts to establish evidence and support theories with visual displays. Latour (1986) explains that the images are constantly being made less confusing by being flattened out, visualized, and diagrammed (p. 15). To elaborate this point, Latour relies heavily on Michael Lynch's (1988) work on the processes of recording and representation in scientific work. Lynch's work is very important in our attempt to understand how it is that images (such as satellite images) which are inherently vague go through a process to become clearer and more convincing—a dominant feature of mapping and visualization. Lynch (1988) states that

> Although the diagram can be seen as a schematic version of the photograph, the photograph is not to be taken as a schematic representation of the diagram. The pair thus shows a sequential ordering; the photograph being an "original" and the diagram a rendering of it. (p. 208)

The original and the diagram are often displayed side-by-side in the scientific work Lynch has studied. In this split-screen arrangement, they allow the viewer to see in the image, that is, to see the structure that is clearly evident in the diagram. In the case of Heller and Pezzani's video we

see the image and the diagram overlapped to ensure that the viewer sees proof of the phenomenon as well as the process of the construction of the proof.

Lynch argues that this form of comparison makes the images more flexible and amenable to being incorporated into more inscriptions. He states that

> Reasoning and vision are intimately associated from the beginning of the rendering process to its end. It is only by comparing one stage of that process to another that we can distinguish relative degrees of eidetic vs. empirical form. As we trace through the sequence of renderings, we see that the object progressively assumes a generalized, hypothetically guided, didactically useful, and mathematically analyzable form. It becomes progressively less recalcitrant to the textual devices of describing, displaying, comparing, causally accounting, mapping, and measuring. (Lynch, 1988, p. 216)

Interestingly, we are not dissuaded from believing in the analysis when we are shown the original work—quite the contrary, we are reassured that there is clear chain of transformations. A process that again aids the narration (i.e. text) of the video gains rhetorical force.

Lynch makes an important observation. Scientific representations, and I would argue visualizations more generally, do not only simplify the phenomena and reduce information to a manageable amount but they also *add* visual features which "clarify, complete, extend, and identify" latent aspects of the phenomena (Lynch, 1988, p. 229). It should be noted that these transformational processes are strikingly similar to Pickles's observations on the mapping process which erases the traces and ambiguities in a map while clarifying and highlighting specific types of features. We can also see in the processes of cleaning, parsing, filtering, and

mining in data visualization that there exists a parallel logic to that observed by Lynch and Latour.[21]

In the frame of the dashboard created by Heller and Pezzani, these processes further coalesce to create a more compelling case against the NATO forces. The diagram in *Liquid Traces*, for instance, works as an aid to perceive the qualities of the photograph. It is annotated, it highlights features and it diminishes the noise in the visual channel. It also makes features more alike and therefore brings out a pattern that can be more easily noticed. For instance, the trajectory of the boat (see Figure 5) is represented as an animation that shows movement from one point to another. Of course this is an interpolation between known coordinates derived from static satellite images and triangulated with other data gathered. But what is presented is a smoothed out and unbroken movement—a passage of time with markers showing significant events during the entire ordeal. What is also accomplished by this representation is the addition of a layer of information that does not exist in any one image (as each image is a frozen moment in time that records fuzzy and ambiguous pixels that may or may not indicate the existence of a vessel at sea).

21 These are the kinds of transformations that mediators perform in a network; according to Latour (2005b), there is never pure transportation between one actant and another, there is always transformation.

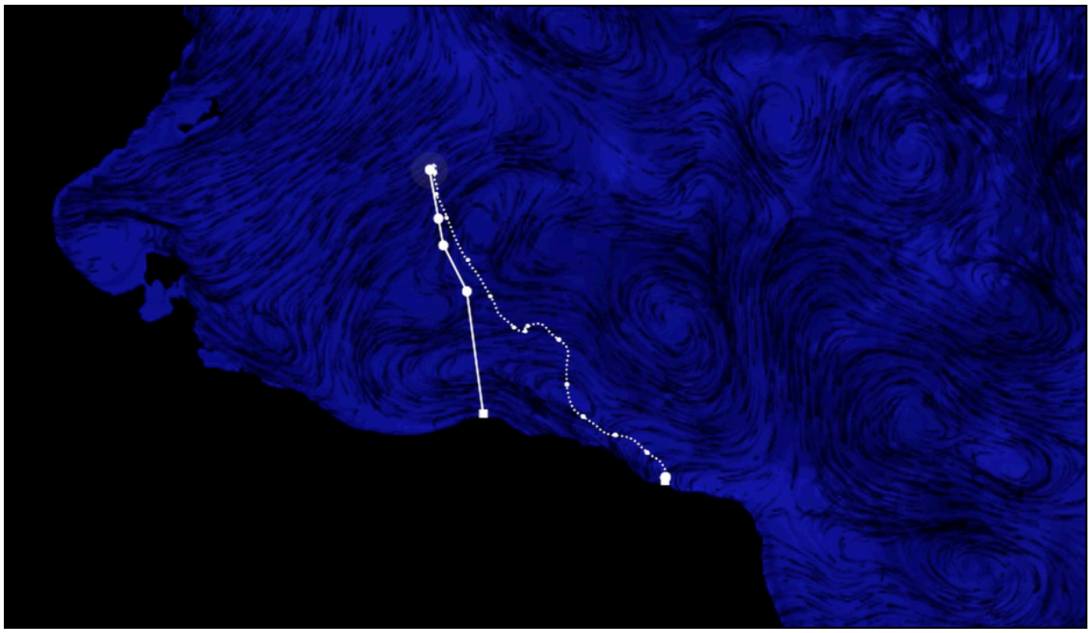

Figure 5. Visualization dashboard showing animated trajectory of vessel (screen capture, detail, bottom). From "Liquid Traces" by Heller and Pezzani (2014).

Cascades

What emerges from this arrangement of data sources and visualizations is a cascade of inscriptions (as described in Chapter Three). The dashboard assembles the images as a series in which any one image, if taken in isolation, becomes mute and only attests to a location or probability of object size. But in concert with other independent reports, ship-spotter websites, official military documents, and eyewitness accounts, these inscriptions are interlinked into a persuasive statement of fact. On the dashboard in *Liquid Traces*, we see excerpts from the Spanish newspaper *El Pais* that show the itinerary of the Spanish frigate Méndez Núñez. This inscription (itself derived and supported by other processes of recording and accounting), when coupled with the map and the satellite imagery, indicates a high probability that the Méndez

Núñez was one of the ships spotted in the area. Higher confidence in the identity of specific military ships is achieved as more sources are piled on top.

The importance of inscriptions being part of a cascade is that they vouch for the validity and strength of that particular inscription. As Latour (citing Daston & Galison [2007], 2010) suggests, "any given image is always preceded or followed by long series of graphs, tables, equations, legends, and paragraphs, and it is the series in its entirety that can be said to 'have a referent' or to prove something incontrovertibly" (p. 588). In other words, the inscription is allied with other inscriptions that support its claim. It is another signpost which the navigator-reader consults on the way to apprehending an issue. If an inscription is isolated from this cascade and regarded on its own, it loses its value, according to Latour. This is especially the case for scientific inscriptions (e.g. visualizations, journal articles) which in isolation would lose their scientific value (Latour et al., 2010).

Navigation Over Correspondence

It may be tempting to consider the *Liquid Traces* dashboard as an object that points to one statement of fact: the presence and criminal negligence of NATO forces in the area which led to the loss of many lives on the refugee boat. To be sure, this is the aim of Heller and Pezzani in making this video, generating the report, and participating in the legal cases against the NATO governments involved in the incident. Yet, the dashboard-as-visualization-as-video, through one of its principal characteristics—time—takes on a processual and *navigational* character.

The *Liquid Traces* dashboard mimics the calculation interface that Latour describes as a tool for creating a processual relationship between a variety of representations and data sources. A conventional notion of maps (or visualizations) would hold that they are representations of a territory and their quality is evaluated by how accurately they reproduce salient details of the territory. This is the *mimetic* role assigned to visualizations that Latour finds lacking (Latour et al., 2010). Digital maps for navigation are dashboards that assemble heterogeneous data sets. They are a navigational platform that integrates databanks, interfaces for data handling, and creates different outputs for different users. Thinking of maps as dashboards through which a navigator continually calculates distances, presence of risks, positioning, bearing, etc. clarifies the ways in which visualization is a process that entails "anticipation, participation, reflexivity and feedback" (Latour et al., 2010, p. 581).

Key to understanding the need for the navigational form of mapping and visualization is the knowledge that "truth," as a faithful correspondence between representation (map) and reality (territory), is not tenable. But, as Latour argues, correspondence among inscriptions—such as those assembled on a dashboard—can afford a processual relationship of navigating space that involves comparison, juxtaposition, calculation, and correction. He states that the navigational works precisely because it is not mimetic. It doesn't resemble the territory; rather the various sets of data bear some relation to the map being used to navigate—and thus a back and forth process of finding correspondences ensues (Latour et al., 2010, p. 586). Despite the non-interactive nature of the *Liquid Traces* video we can see how correspondence is thus built between different sources that point to the high probability of NATO vessels (and commercial vessels) being in the vicinity of the refugee boat. As viewers, and as navigators, we develop an

understanding that the organizations mandated with helping civilians intentionally neglected the boat and effectively left the refugees to die on the sea.

With navigation, Latour invites us to think of the ways in which we use and perform visualization rather than focus on space that is represented. A convention in geography and cartography is the privileging of the base map as real foundation for all successive (thematic) layers piled on top. This, ostensibly, assures a level of accuracy and confidence that the subsequent layers are meaningful because they operate in real space. Through Latour's conception we can say that the space being represented instead emerges through its visualization. The space seen in *Liquid Traces*, for instance, is not at base the Mediterranean Sea with all the rest on top of it but rather a composition (or perhaps a *composing*) through which a multitude of processes bring sources into contact with each other. This, in turn, allows the navigator-user-viewer to observe successive *signposts* which help find a bearing, a trajectory, or the presence of an object.

The visualization and report created by the authors is largely done through the use of existing material. This signals the fact that the author's report and, more significantly, the dashboard video act more as a re-analysis and rethreading of existing secondary data. The authors acknowledge the importance of news reports and publicly available documents about the incident with specific reference to the "Lives Lost in the Mediterranean Sea: Who is Responsible?" inquiry led by a Dutch Senator.

Translation

What does such a visualization—as an actor-network—do? Part of the answer to this question lies in the notion of *interessement*. As described in the previous chapter, interessement is effectively a translation of an actor (e.g. interests, voice) into a form within the network that allows the network itself to become an actor—a macro-actor. Latour and Callon have used this concept to describe how organizations and institutions assemble and translate other actors in order to act as a macro-actor. But this concept can also help us understand how visualizations enlist other actors.

As discussed thus far in the case of *Liquid Traces*, the visualization does not just assemble nonhuman actants (e.g. letters, reports, imagery) into a stabilized network, it assembles the interests of human actants (e.g. refugees). What is translated in this process is the voice of an actant (e.g. the survivors' and the other refugees' experience) into a component of a network that, in turn, becomes another actant that contains these translated actants. By being video-recorded through the interview, Dan Heile Gebre is thus enlisted into the case—not only as a plaintiff or survivor but as stakeholder. Gebre is not just a subjective observer but an expert witness who now represents the reality of having been on that boat during that journey. The *Liquid Traces* visualization (and report) now derives more authority from its translated actants. Their incorporation suggests an implicit endorsement and thus the visualization acts and speaks for several actants. In the discussion on the *Anti-Eviction Mapping Project* we will see how this process of interessement works at a larger scale.

Artistic Visualization

Liquid Traces is not simply a visualization and report issued to compel the international community to condemn and prosecute these NATO forces. This project also operates as a creative project that incorporates elements of design and art. While concepts used thus far to analyze the work (such as immutable mobiles, cascades of inscriptions, navigational practice, and interessement) are very useful concepts to help understand the way *Liquid Traces* works, they have less to say about how the visualization works as part of a critical visualization practice that involves a creative process, as well as about how the visualization is also an aesthetic object and experience.

It is also instructive to note how Latour makes a clear distinction between certain forms of artistic visualizations and scientific visualizations. He states that

> What is so characteristic of the "art of describing," to use Alpers's (1983) term, is that scientific and artistic visualizations, whatever their many crossovers and overlaps, have one radical difference: scientific inscriptions draw together long series of dissimilar navigational tools, whereas painting defines, by definition, only two endpoints, the prototype and the copy. (Latour et al., 2010, p. 589)

Of course, when Latour talks of artistic visualization, he is specifically talking about Dutch painting and maps as described by Svetlana Alpers. Artistic maps, such as those described by Alpers, attempted to mimetically represent the world and, Latour suggests, contributed to an enduring mimetic understanding of visualization where accurate description was valued above

all. Contemporary artistic and design practices have problematized this relationship.[22] But it does leave unanswered the role of contemporary art and design practices that create aesthetic works that also attempt to have a veridical value.[23]

In the case of *Liquid Traces* we can see that it operates beyond this dichotomy. This visualization is at once an analytical tool for bringing together the relevant evidence to prove the guilt of NATO vessels in the area of the incident as well as an artistic work that employs aesthetic and rhetorical strategies for creating a compelling narrative. *Liquid Traces* also functions as a work of art and design that aims to express both the conditions of its production as well as the magnitude of the crime. It is in this instance that assemblage thinking can help us understand the structures and processes at work within a critical visualization project that builds on what can be described through an actor-network analysis.

Production of Subjectivity in the Assemblage

The cascade's role in cementing value can also be applied to the kind of veridical value in *Liquid Traces* which the creators took great pains to build. The cascade concept describes its role in a network that produces the visualization, the practice that upholds it, and the claims it is making. This model intentionally dismisses the subjective dimension involved in the cascade. As has been discussed, the subjective is deemphasized in ANT-thinking due to the lack of suitable

22 See the work of Julie Mehretu, Guillermo Kuitca, and Marcelo Serrano for examples of artists using maps that float between mimetic, affective, and compositional strategies.

23 Latour has curated at least two exhibitions (*Iconoclash* and *Making Things Public* at the ZKM in Karlsruhe, Germany) that present a variety of works that bridge art, design, and scientific representation.

traces that can be collected and accounted for. We can add another dimension to the notion that value in the inscription is maintained through its being lodged in a cascade or network—namely, subjectivation within an assemblage of enunciation. If scientific value contributes to the authority of a specific claim made by an inscription, it would stand to reason that subjectivation contributes to the relative strength of the assemblage.

As Lazzarato (2014) has indicated, subjectivation involves the assemblage of humans and nonhumans along with the process of enunciation: "The production of subjectivity is indeed a 'collective' process, yet the collective both goes beyond the individual, in an extra-personal dimension (machinic, economic, social, technological systems), and precedes the person (preverbal intensities within a system of affects and intensities)" (p. 57). This draws from a notion of *affect* which Deleuze and Guattari (2004) define as the ability to act on a body. Their concept and use of affect is not simply feeling as such, but rather puts the emphasis on acting upon or affecting. Affect is coupled with the notion of percept. Deleuze and Guattari carefully separate affect and percept from what affections or perceptions may entail. They are instead basic elements that make up a "bloc of sensations" (Deleuze & Guattari, 1994, p. 164). These are pre-linguistic, pre-conceptual, non-signifying processes that produce experience.

One of the ways to produce sensations is to employ aesthetic techniques. The aesthetic techniques employed in *Liquid Traces* attempt to invite the viewer to feel and experience particular aspects of the narrative. Pezzani and Heller incorporate sounds, voice, video, text, diagrams, and animation to produce this experience. Before we are presented with visual information in this visualization-video, we hear sounds that submerge us into the experience of the territory. The soundtrack that accompanies the narration and visual information is composed

of deep ocean underwater sounds remixed to elicit a sense of the volume of the vast sea and the powerful movements of its currents.[24] The sound corresponds to the graphic vectors of currents that begin to fade in on the dashboard.

With only the silhouettes of the coastlines visible, the dark and menacing map is vaguely reminiscent of what it may look like to navigate these waters at night. The narrator begins: "Modulations of the sea's ever-moving surface immediately fold back into its immense liquid mass" and asks, "What traces might deaths at and through the sea leave? How to recreate violations when the murder weapon is the sea itself?" (Pezzani & Heller, 2014, 00:19). As the narrator continues, the dark map becomes a dashboard that divides the visual space into specific areas for dates and timelines, inventory of datasources, thumbnail views of data, and the map itself with annotations. The stage is set for a making a case through the use of rhetoric, allusion, as well as evidence.

At a later point in the video, the dashboard (and map) again becomes dark as the narrator describes how an army helicopter that had spotted the boat begins to leave the area. When night comes for the refugees and visibility at sea is reduced, night comes for the viewer and features of the map are more difficult to discern. The viewer is brought into a relationship with the map that is not simply that of objective viewer or neutral adjudicator of evidence but as a kind of participant that, while not positioned in the boat with the refugees, relies on a subjective involvement in the events being described. The viewer doesn't just know that it is more dangerous at night, the viewer also feels it.

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24 The sounds are sourced from the *Listen to the Deep Ocean Environment* project at the Laboratory of Applied Bioacoustics at the Technical University of Catalonia, Spain (BarcelonaTech, UPC).

Just before the main map displays the trajectory of the refugee boat, a portion of the interview video with survivor Dan Heile Gebre is shown in the corner of the dashboard. At several points later in the visualization video, the interview will reappear to support the claim made by the diagram on the map. He offers eyewitness testimony of the ordeal suffered on the boat and of the presence—but non-assistance—of military vessels. Despite the authors' intention to focus in the interview on the precision of the recollection in order to buttress the reconstruction of the case, the inclusion of the testimony does add a subjective dimension that allows the viewer to approach the experience of the tragedy. Beyond corroboration, Gebre's voice and account of the event bridges the distance inherent in the Apollonian view of the boat's trajectory. We are thus confronted with the body of one refugee and thus metonymically with the other bodies of the refugees who occupy the minuscule group of pixels on the digital map. We are brought into a form of contact with the reality experienced by Gebre.

While we (the viewers) are affected, perhaps changed, through this contact with the survivor, the survivor is transformed by virtue of being enlisted in the visualization and report. Through this presentation of the interview and the presentation of the roles of the actors within the incident, *Liquid Traces* creates a series of incorporeal transformations that reconfigures the identity of these actors and their relationships. Through this process of enrolment in the case against the NATO countries, Gebre has been transformed from refugee to survivor to witness. He is designated as a material witness in the case and therefore occupies a much different position than undocumented refugee—he takes on a new authority.

Beyond the affective register, the assemblage which emerges through the project also makes *incorporeal transformations.* As discussed in the previous chapter, incorporeal

transformations reframe humans and nonhumans within an assemblage that can affect their conditions. In the case of *Liquid Traces*, we see how the process of visualization may carry out similar transformations through the ways that it assembles its objects. For instance, the visualization itself attempts to transform the water on which the incident occurred into an object. The water is incorporeally transformed when the Mediterranean Sea becomes a murder weapon. Vectors of sea currents show the fluid dynamics that can create eddies and flows that can either misdirect a vessel or project it quickly towards its destination. The narrator reminds us that the project's goal is to "reconstruct a violation when the murder weapon is the water itself…what are the conditions that transform the sea into a deadly liquid" (Heller & Pezzani, 2014, 00:37). Apart from the use of metaphor, the visualization carries out an *illocutionary* act of designating the sea a weapon that is wielded by the NATO forces in the area.

If we recall the common example that illustrates the notion of incorporeal transformations in an assemblage—the judge's pronouncement of guilt on a defendant transforms the person from suspect to convict—the similarities to the current project are productive. The *Liquid Traces* project acts prefiguratively by stating the verdict as strongly as possible outside an actual court. Through a transformation, the murder weapon is produced. Through a similar transformation, the military vessels, ostensibly with missions to ensure security and safety, are transformed into vessels that effectively murder refugees.

Considering visualization as a network or assemblage requires us to include the process of data collection as a key component. This process makes a difference in the visual representations made. At the sites of data collection, the participants in the process are also transformed. For instance, as we extended the assemblage to the process of the interview with survivor Dan Heile

Gebre we saw that he was transformed from survivor to expert witness. He is also translated in order to satisfy the requirements of the project to legitimize all accounts of the incident. This process conforms to the notion of *interessement* discussed earlier—the processes (in a visualization) that bring actants together. It is the translation of actors into a configuration that supports the stabilization of the network. Yet what the interview reveals is the *subjective dimension* of being enlisted into the network through interessement.

Gebre is surrounded by equipment that can increase his cognitive and communicative competence. Since the report authors needed their interview with Gebre to proceed in a manner that would best support the building of their case, they used accessible tools such as pen and paper to explain terms and specific questions to facilitate the recollection of precise elements of the narrative (e.g. time of day, speed of boat, fuel consumption, colour or shape of vessels encountered). In addition to sketches, throughout the interview, maps and images were used. Maps, for instance, were used as memory aids and as presentation aids for explaining the chronology of events, the trajectory of the boat, and the locations of potential rescue vessels. Images of boats or aircraft, similar to the ones likely to have been in the area during that time, were used to add or confirm specific details. None of these images were treated as photographic evidence of the tragedy but rather as elements that when assembled would leave very little doubt as to who was responsible for leaving the refugees to die. They worked as devices that, due to their own limits, could not and did not represent exact and fully rendered aspects of the event. They instead allowed for the interviewer and interviewee to approximate the relative points of the whole story.

At the beginning of the interview, Pezzani (the interviewer) thanks Gebre for agreeing to, once more, discuss his experience of the ordeal. He makes special note of how he can only imagine how painful the act of the retelling his experience must be and thus thanks him again. This is further acknowledged by the presence of Father Mussie Zerai during the interview. Zerai is a member of the clergy at the Vatican who the refugees had called via satellite phone after their first day at sea. He is present in order to both vouch for the legitimacy of Pezzani and Heller as well as offer some measure of safety for Gebre who is still in a vulnerable position and who could be further victimized through this process.

The research apparatus (i.e. researcher, participant, table, chairs, room, recording equipment, a table, pen and paper) is necessary for the extractive process of the interview, but the interviewer's acknowledgment of Gebre's trauma, the informal setting, and the familiar face of Father Mussie are equally necessary for the affective dimension of the interview—the purpose of which is for Gebre to recount the terrible details of the journey on the boat over the 16-day period. By remembering and retelling the events in sequence he undoubtedly relives the trauma. This interview process is not simply the enlisting of an actor's presence and expertise in the function of strengthening the hold on a particular issue. It is also the production of subjectivity at different clusters in the assemblage. The interview during data collection is one such cluster. Other clusters can include the presentation of evidence at press conferences, the discussion of materials at workshops, the viewing of the video at festival screenings, or even the viewing of the video online. The assemblage in the case of *Liquid Traces* comprises the viewing, the sharing, the collection of evidence, the performance, the judgment, the survivors, the documents, and the imagery.

The report, materials, and visualization video have been demonstrated, screened, presented, workshopped, recombined, and repurposed through a variety of events, platforms, and organizations. To begin with, the *Liquid Traces* video, currently hosted on the Vimeo video-streaming Internet service, has been played approximately 4,500 times in two years.[25] These viewings come from visitors to the Vimeo site from a link shared via e-mail or social networking website, or from visitors viewing the video embedded in a third-party site. The video has been screened internationally: notably, at SabirFest (September 2014), in Messina, Italy—geographically very close to Lampedusa (the refugees' original destination) and Libya. Also in September 2014, *Liquid Traces* was screened at CineCycle in Toronto, Canada with the support of the Department of Geography, University of Toronto. Pezzani attended this screening and contextualized the issues facing refugees in Europe. As part of an effort to continue dissemination, outreach, and discussions at the Forensic Architecture research group at Goldsmiths University, Pezzani and Heller participated in a multi-day workshop on Forensic Oceanography. This workshop focused on political context, refugee experience, methods of data collection, analysis, and presentation. Not unlike the press conference described earlier, these screenings and workshops are also performances that create aesthetic experiences for presenters, audiences, and participants alike. The visualizations and reports (i.e. inscriptions) are part of stagecraft in employing percepts, producing affect, and augmenting cognition. Interestingly, the work in *Liquid Traces* has also been recreated by news agencies. For instance, *The Guardian* created an interactive map for its online edition (Allen, 2012). This visualization (see Figure 6)

25 This metric, as of January 15, 2016, is available on the video's hosted page at: https://vimeo.com/89790770.

took the trajectory developed by Pezzani and Heller and highlighted the sequence of events as compiled in the *Liquid Traces* visualization. *The Guardian* also included Pezzani's interview with survivor Dan Heile Gebre in an article detailing the different vessels and NATO forces that had come in contact with the refugee boat (Shenker & Willsher, 2012). These examples of how the *Liquid Traces* project has been reproduced underline the importance of why we need to think of visualizations as both processual and as assemblages or networks. These instances are effectively part of the visualization project. They are an intended outcome of the visualization and ultimately refer back and support the claims made. It is through this lens that we can better analyze how they work, how they make claims, who and what they enlist in their production, and what affects they may produce.

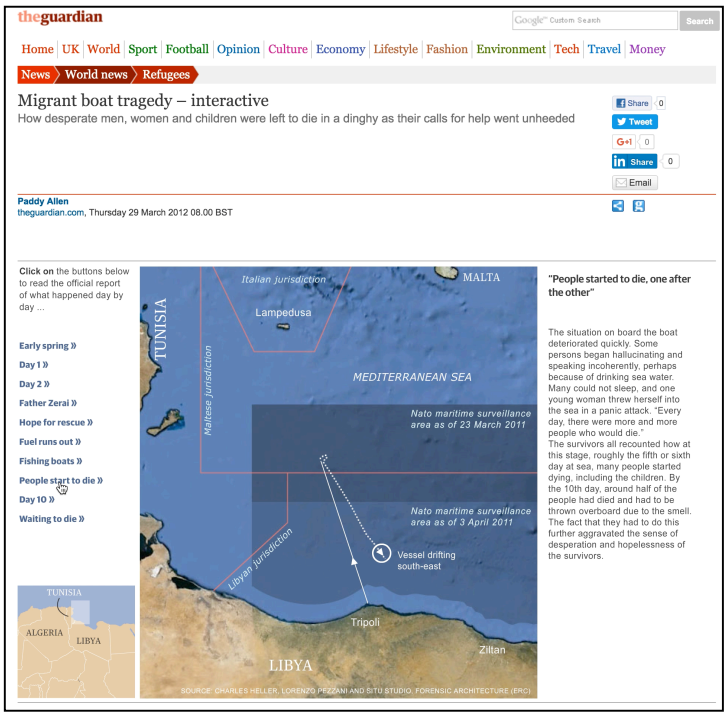

Figure 6. Guardian UK interactive map (screen capture) by Allen (2012) reproducing Liquid Traces data and visualization.

Anti-Eviction Mapping Project

The *Anti-Eviction Mapping Project* (*AEMP*), produced by the San Francisco Tenants Union, offers another example of how these networks and assemblages may be represented and experienced. The *AEMP* doesn't employ a dashboard to accomplish this goal. Instead, an even more widely distributed set of events, performances, interfaces, and representations make up the assemblage. The *AEMP* website serves as a hub for providing access to the maps it has produced, oral stories it has compiled, and tools it has developed as well as the latest news regarding projects, solidarity efforts, and local news on policy, court decisions, etc.[26] *AEMP* has produced over 30 maps which are available to visitors on its site. The project also provides a list of "Gentrification Players" so that users can better identify the key individuals and organizations that are responsible for the rise of aggressive hypergentrification. The site also serves as a means for data gathering—it has several tools for users to contribute their own stories to the project's documentation archive. It also provides tools for users to employ in their fight against evictions. From this site we are able to access several projects by the *AEMP*, including *Ellis Act Evictions*, the *Narratives of Displacement Oral History Map*, the *Clarion Alley Mural Project*, and the *No-Fault Evictions and Tech Bus Stops*. I will focus on these interrelated *AEMP* projects to show how networks and assemblages are formed and how they can be deployed in acts of resistance.

26 The project can be accessed at http://www.antievictionmap.com/.

Expressing a Matter of Concern

AEMP is an attempt to make visible a *matter of concern*. It can be seen as a *network of actors* and an assemblage that expresses, as well as a *machine of subjectivation* that employs signifying and a-signifying semiotics. It does this by visually representing the pattern of displacement of tenants, and re-presenting the voices and desires of the displaced tenants and activists.

If we recall, Latour's notion of a matter of concern attempts to encapsulate the dynamics between different assemblages that work towards establishing the ontological status of a given issue. The matter of concern, in this case, is essentially the gentrification of San Francisco, which involves the displacement of tenants—many of whom are lower-income, people of colour, and recent immigrants. While the municipality represents the revitalization and real estate investment in the area as a positive development for the city's wellbeing, the *AEMP* represents the externalized human costs of this development.

Central to understanding the mechanism by which tenants are displaced is understanding the use of the Ellis Act, a municipal by-law that exists in many cities in California; it was originally designed to allow property owners to evict tenants in the event that they themselves needed to move in. The Act also allows owners of multi-unit buildings to evict tenants in order to do renovations that convert the building to a single-family dwelling. This provision, according to many, including the San Francisco Tenants Union, activists, lawyers, and the *AEMP*, has been systematically abused by property owners and developers to evict low-rent tenants in order to bring in high-paying tenants. This has resulted in a 75% increase in evictions in two years.

AEMP refers to these Ellis Act evictions as *no-fault evictions*. They are the key variable that is plotted in many of *AEMP*'s interactive maps. The data is procured from the San Francisco Rent Board which publishes annual eviction reports in aggregate form but also offers access to specific eviction cases.

The Ellis Act interactive maps, which are also often shown as animated timelines, show the rise and spread of evictions by property owners ostensibly moving into the building (see Figure 7). The user can click on the *play* button in order to start the timeline animation, which shows a chronological sequence of evictions from 1997 to 2014, totalling 3,775 families evicted. Each eviction is represented by an exploding marker which alludes to the devastation a bombing run might have had on a city in World War II. The visualization has a rhetorical force that is easy to detect—with each impact shown on the map the number of families affected increases. When more families are evicted at once, the explosion is proportionately greater.

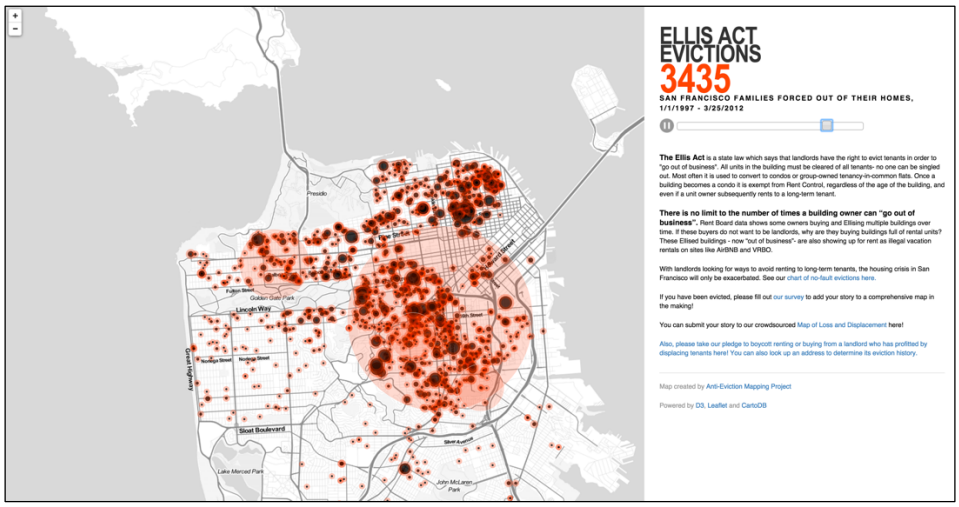

Figure 7. Interactive map (screen capture). From "Ellis Act Evictions" by Anti-Eviction Mapping Project (n.d.-a).

In addition to the website and their social media presence (e.g. *AEMP*'s Facebook page has almost 4,000 followers and approximately 1,500 Twitter followers as of August 15, 2015) the *AEMP* has also used the local, national, and international news media to its advantage by being covered in over 200 separate news stories in just over 14 months. One of these stories is by AJ+ (i.e. Al Jazeera's millenial-oriented social-media news platform) and takes the form of a 32-second YouTube video that repackages an *AEMP* (no fault eviction timeline) map visualization by animating it along with titles, captions, and a soundtrack (AJ+, 2014) (see Figure 8). This treatment of the original Ellis Act Eviction Map further augments the rhetorical force of the visualization by dramatizing the human dimension of the issue and adding a sense of urgency with a sombre yet rhythmically driving soundtrack. The clip ends with an AJ+ announcer telling the viewer that if they want more information and want to join the conversation they can download the AJ+ mobile app.

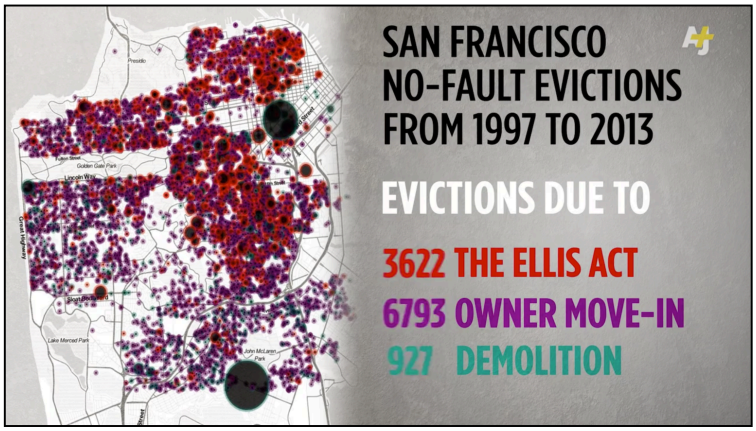

Figure 8. Reproduction of *AEMP Ellis Act Evictions* map as a video (screen capture). From "Mapping San Francisco's No-Fault Evictions Since 1997" by AJ+ (2014).

This adaptation of the original eviction map illustrates how visualizations are circulated and repackaged in an era of *data journalism* (European Journalism Centre & Open Knowledge Foundation, 2012). The recent surge in the creation of data stories by major news organizations (e.g. *New York Times*, *The Guardian*, *Washington Post*, *ProPublica*) has inevitably been both a source of inspiration for the *AEMP* and factor in the popularity of its visualizations. Data-driven visualizations and compelling illustrations of dramatic changes over time are presently highly-valued content for these media organizations—*AEMP* has both. This is also evidenced in the case of the *Liquid Traces* visualization which was re-drawn or re-edited in articles for *The Guardian*.

The *AEMP* currently has two versions of this map—one detailing the occurrences in San Francisco and the other in Santa Monica. Using the same design—visual style, format, mapping cloud-service, and code—*AEMP*, in collaboration with the Pico Neighborhood Association and Rent Control Board of Santa Monica, has created a map that shows the same issue that is plaguing San Francisco occurring in other parts of California.

In both the evictions maps (e.g. San Francisco and Santa Monica) and in the AJ+ news clip we can observe a fairly consistent visual style which has added impact each time it has been used. But the visual surface of the map speaks only to one dimension of the power of the visualization to travel across different registers. The other dimension is the data itself, which has been recombined with other data sets to bring out a related insight through the representation of patterns that draw initial and potentially alarming correlations. For instance, Erin McElroy and Andrew Szeto, in their presentation at Allied Media Conference 2015 in Detroit, note that the areas with high evictions are correlated with the areas where there has been an increase in Tech

Shuttle Bus stops (i.e. pick-up points for the privately operated luxury buses for employees who commute to several of the big tech company employers in the surrounding area).

To illustrate this correlation *AEMP* created the *No-Fault Evictions and Tech Bus Stops* map (Anti-Eviction Mapping Project, 2013). *AEMP* used Stamen Design's (2012) *The City from the Valley* project as a basis to create a map with two important layers: markers showing Tech Bus Stops and areas with high numbers of evictions.[27] This combination demonstrates an apparent correlation between the location of bus stops and the higher rate of evictions. On the website they offer an analysis which states that "69% of No-Fault Evictions each year occurred within four blocks of known shuttle stops" (Anti-Eviction Mapping Project, n.d.). This would suggest that the evictions are an effect of the high desirability of well-heeled tech employees to property owners who exploit no-fault evictions designed to evacuate buildings for renovation, and then offer the improved units at higher prices.

This use of the maps suggests that it is important to consider the power of how visualizations can travel from one context to another and how they can be reassembled and reconfigured with other data. Although Latour's notion of *immutable mobiles* is extremely useful in understanding the cognitive, representational, and administrative capacities of visualizations, it is less useful when considering the work of *AEMP*, even if we select just one map and trace its trajectory. This is because the San Francisco map and data are re-used in a number of ways (e.g. Youtube videos, murals, other maps, oral history maps). The *map* is therefore multi-sensory,

27 According to Stamen Design, at the time of making their map the location of the tech bus stops was not public knowledge. Therefore, in order to create a database of locations and types of bus stops (e.g. which company ran which bus) Stamen first looked at informal listings on sites like Foursquare but soon realized that they needed to enlist cyclists to make and record field observations that could then be digitized and compiled—a process which used Stamen's own Field Papers technology.

multi-dimensional, multi-platform, or multi-media. Its *mutability* is precisely the feature that allows *AEMP* to flesh out an issue and reach a diverse range of users and viewers. The same issue of Ellis Act evictions is documented in San Francisco and in Santa Monica. By using the same design and inserting the data and information specific to the municipality, *AEMP* increases the strength of the argument against these displacements.

This is also somewhat different from Latour's concept of the *cascade of inscriptions* which entails a series of related or allied diagrams, maps, reports, etc. that strengthen the veridical value of the visualization. Similar to how the cascade involves a process of building a fact, the maps/data of the *AEMP* also attempt to stabilize their *concern* into a fact. But the difference lies in how it is not a procession of inscriptions of which any specific visualization can be part of but rather a multiplicity of visualizations. It is, instead, expressive. It entails a variety of non-linear outcomes of a mapping process. At times, it resembles a previous map, as in the case of the AJ+ video, because of the data used. At other times, it resembles the style of a previous map but the data is different and the location is different, as in the case of the Santa Monica map. At still other times, the map is expressed in completely other forms including media and kinds of embodiment.

The power of this expressivity is evidenced in how the *AEMP* uses its suite of maps to present the different strengths of quantitative and qualitative data. For instance, *AEMP* uses data analysis and visualization along with the human voice to retell the experience of community and dispossession. We see the same data now assembled with recordings and images of residents and

survivors.[28] While the technical process is a relatively straightforward layering of data (eviction data with geo-located audio files) the result represents an expressive transformation of form: the evicted tenants are represented in the eviction maps, and some of these same tenants are represented through their stories. Using Deleuze and Guattari's notion of expression we can see that while the content (i.e. the tenants) remains the same, the forms of expression proliferate (dots on a map and voices in your ear).

From Interessement to Assemblage

Like the *Ellis Act Eviction Maps*, the *Narratives of Displacement Oral History Map* plots the number of no-fault evictions through the use of circle area markers, on a standard Mercator-style projection of the city area and quickly shows the magnitude and expanse of displacements in the San Francisco Bay Area (SFBA) over the past several years when they have soared alongside real estate speculation and the increasing influx of tech startups and big tech company (e.g. Google, Salesforce) employees to the surrounding area (see Figure 9). Unlike the eviction maps discussed above, this map shows all the evictions over the past two decades at once. This way, at a glance, we can evaluate the concentrations of evictions and determine that they tend to gather in the Mission District and other neighbourhoods further to the north and west. This recalls a classic pattern of gentrification whereby lower income neighbourhoods—historically

28 *AEMP's* project thus combines mapping with ethnography—the Apollonian gaze (Cosgrove, 2003) with the survivor's testimony. Rather than privilege the all-seeing view-from-above, these other projects humanize the map by revealing the territory.

with lower property value and which have been inhabited by new immigrants, artists, and workers—are rapaciously and systematically purchased for investment and new construction.

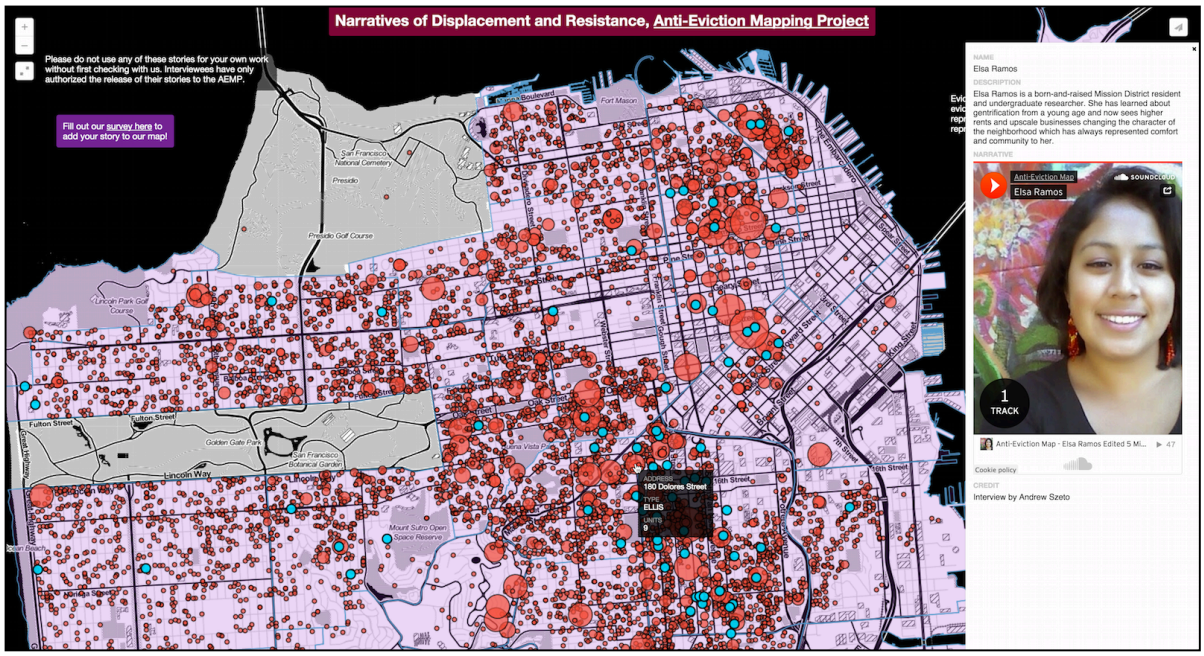

Figure 9. Interactive map (screen capture). From "Narratives of Displacement and Resistance" by Anti-Eviction Mapping Project (2015b).

Although the work done by the *AEMP* is useful and necessary, Erin McElroy, one of the project leads, notes that "dots on a map don't tell the whole story" (McElroy, Wojczuk, & Tirado, 2015). The visualizations themselves as representations of a distribution of values show an overview of a phenomenon that necessarily reduces the individual events to data points where differences between data points are eliminated except for time and location. The subjective dimension of each event is missing. The oral history map is an attempt to further our understanding of the impact of displacement by addressing this tendency of maps and

visualizations to flatten differences and erase messy data (Pickles, 2006, p. 349). In this map, two kinds of markers are used to represent the quantitative data and the qualitative data: firstly, red circle markers, whose size corresponds with the number of evictions, are used to represent buildings; secondly, blue circle markers are used to represent the profiles and stories of specific tenants. Users can hover over the red markers to see eviction information (i.e. building address, eviction type, number of units) or hover over the blue markers to see the tentant-interviewee profile. Clicking on the blue circle brings up a larger description panel with several media that can be played.

The stories gathered for the oral history map come mainly from three different processes. Some of the interviews come from volunteers reaching out to people affected by displacement and interviewing them for the sole purpose of the map. Others are gathered from a related event entitled Campfire: Eviction Ghost Stories and Other Housing Horrors, held the year before in San Francisco. Additionally, visitors to the site are offered the opportunity to add their own story through an online survey tool. Although organized through different initiatives, these activities offer similar opportunities for survivors of displacement to add their own testimony to the official record and history of the phenomenon.

From an actor-network perspective, the collection of oral storytelling from people who have suffered and/or survived eviction constitutes a form of *interessement*. The voice, identity, and testimony is thus translated into a network that enrols actants and mobilizes these connections in a well-structured issue—an attempt to significantly shift the frame of a matter of concern, for instance. As described in the previous chapter, Latour and Callon's concept of translation (Callon, 1986; Latour & Callon, 1981) also includes several other processes that

outline a specific form of power arrangement between, for instance, a researcher and a collectivity of human and nonhuman actants. *Obligatory points of passage* can place the researcher in a powerful position that manages the collective voice. *Problematization* frames an issue such that the researcher becomes indispensable. *Enrolment* brings the human actants into the network. *Mobilization* transports the issues in the network (via visual representations, etc.) to media, venues, and other networks that may serve the purposes of the researcher.

We can see how the *AEMP* has problematized the issue of unlawful evictions, set itself (and its parent organization, the San Francisco Tenants Union) as a nucleus of activity, enrolled storytellers, and mobilized the issue through their maps, etc. In this way, the *AEMP* loosely conforms to the model of interessement. But the model specified by Latour and Callon puts too much emphasis on the management role that translates a collectivity of actants into a larger actant. Gatekeeping and the stabilization of the network through the transfer of power from the collectivity to the manager may describe how particular forms of visualization or networks that use visualization may function, but for the purposes of understanding a critical visualization practice it is this very power dynamic that is questioned.[29]

Although there is a form of translation in the project that enrols storytellers into the project and mobilizes their experiences, the phases described by Latour and Callon do not fit a critical visualization practice such as the *AEMP*. For instance, Erin McElroy, one of the members of the project, states that their aim is to work in a mutual-aid model that attempts to not just work for a community but share resources amongst community members (McElroy et al., 2015). But if we

29 Star's (1990) concept of boundary objects works similarly as a way of understanding the process of interessement, but attempts to model it in non-hierarchical terms.

apply the notion of assemblage to this multi-dimensional project we can see several features that help us understand how it operates beyond a frame of translation.

As part of an assemblage of enunciation these events help make incorporeal transformations, for there is an attendant form of empowerment wherein the storytellers are transformed from victims of displacement to survivors and sources of knowledge. This transformation from victim to survivor and knowledge bearer is reiterated through the oral history map itself. People are also designated as tenants and furthermore designated as humans with intrinsic value. They are incorporeally transformed from simply renters to community members. We saw a similar process in the *Liquid Traces* project where refugees became survivors who became expert witnesses in the case against the NATO forces.

This process operates through other sites as well. For instance, the *AEMP* project as a whole produces an incorporeal transformation of the city itself. Its enunciations designate San Francisco as a city under attack from investors, and where community members resist displacement. This counters or complicates any number of other notions of the city as a liberal stronghold of tolerance or a prosperous "smart city" buoyed by the successes of Silicon Valley.

It is useful to also consider how assemblages, especially those that comprise social movements, use expressive components. Manuel Delanda (2006), using the work of Charles Tilly, notes that the expressive capacities of assemblages are often in the service of establishing membership and solidarity, problematizing categorizations imposed by government, and communicating the magnitude of the movement (p. 59). In Latourian terms, these expressive capacities are also particularly powerful in the advocating of matters of concern.

This is accomplished through the connection that is made to the issue, the project, and the larger community. This connection is sometimes framed as an act of solidarity or healing. For instance, on their Facebook event page the organizers state:

> We are using an old form of oral storytelling to share eviction experiences with each other. We hope the storytellers will feel accompanied by those gathered, and that there will be a little magic in the circle to help the storytellers heal some of the loss. (Camarena, 2014)

The data and stories, while representing a physical space, exist as digital or virtual spaces that are accessible from around the world through a computer and an Internet connection. Story collection can also work this way: there is a call-out and link on the oral history map that urges users to add their own story relating to displacement in the city. This design has particular capacities that allow the stories to travel fast and far—something that has been used by the *AEMP* to great effect. As an expressive component of an assemblage this facilitates not only the connection to other assemblages, but also the growth and continuing stability of the assemblage.

Veridical and Expressive Visualization

Territorialization of the assemblage's expressive capabilities can also contribute to the solidity and identity of the assemblage (DeLanda, 2006, p. 59). In the present case, this can mean solidifying of the identity of the residents as survivors while locating this precisely at the heart of the neighbourhood heaviest-hit by gentrification. A tangible form and specifically-located instance of the map would have a set of characteristics, complimentary to the ones online, that would allow for preserving memory and honouring the stories of survivors. These are priorities

which, we can imagine, propelled the *Clarion Alley Mural Project* in San Francisco's Mission District to ask the *AEMP* to create a mural about the work being done on displacement in the area (see Figure 10). This led to a physical mural which records the history of successful resistance and the struggles made by different tenants who fight eviction in the area—many of whom have successfully fought eviction attempts (Menchini, 2015). The mural was a collaborative effort by a group of volunteer artists and community members organized by the *AEMP*; it comprises a 20-foot painted mural on Clarion Alley which joins Valencia and Mission streets (Anti-Eviction Mapping Project, 2015). The *Ellis Act Evictions* map (which is on its way to becoming iconic through its repeated use across platforms and projects and due the recognizable form of the San Francisco Bay Area shoreline) is painted on the mural along with the portraits of several interviewees from the oral history map. The overview of the phenomenon is combined with the faces of the people which in turn represent personal stories. The personal stories are accessible through a local phone number posted on the mural. This is therefore also a locative media project wherein people who visit the mural can listen to the testimony and stand at the epicentre of the displacement crisis. Its location is also very important symbolically, according to Claudia Tirado, one of the storytellers, for it is very close to the local police station and the alley on which it is painted joins two major Bay Area streets: Valencia and Mission (McElroy et al., 2015). In addition, the *Clarion Alley Mural Project* has become an open-air public gallery as it is a site of a vast amount of murals that run the whole length of the alley on both sides. The site itself is a reminder of the ongoing grassroots creativity of the local residents and their connection to political resistance throughout the decades.

Figure 10. Volunteer painting mural. From "Clarion Alley Mural Project" by Anti-Eviction Mapping Project (2015a).

At the inauguration of the mural, McElroy reminded the attendees that the mapping project, although it started as a simple visualization, has grown to add layers of the story. The mural specifically also adds intersections within the current housing crisis in the SFBA, such as racial profiling by police, reduction in affordable housing, and violence against homeless people, which are important to understand as different dimensions of a complex problem (Menchini, 2015). As one approaches the corner where the alley meets the main street, one can see the mural.[30] Perhaps the most distinguishing marks are the circles with portraits of the storytellers; next is the familiar map (very similar to the evictions map) in the bottom centre. It is immediately readable as a story (or set of stories) about a place. Claudia Tirado, one of the

30 My experience of the mural has been solely through the use of recorded video, maps, and Google Street Views.

storyteller–interviewees, notes that the mural is particularly successful because it is logical and visually comprehensible. Murals, according to Tirado, can be very "artsy" but this mural "zeros in on the problem"; it is also "data-driven" but retains the emotion of "who is being displaced" (McElroy et al., 2015). This is an important and illustrative remark. As a teacher, as a parent, as a resident, and as a participant, Tirado finds the mural to function beyond artistic representation and rather as a visualization that has an indexical link to the events occurring in the area. The combination with portraits and oral testimony further adds to the evidence being presented but retains the emotional impact through the use of voice and human faces. It also reminds us of the promise of artistic visualization, and critical visualization practice more generally, that combines the veridical with the expressive in such a way that concerns are stabilized and cases strongly made, but the connections to the assemblage of human actants are acknowledged.

The active work in maintaining the assemblage and ultimately the community of workers, tenants, and advocates is also exemplified in production of a zine. The stories from the map are transcribed and included in *We Are Here: Oral Histories of San Francisco*, produced by the *AEMP*. In zine form, the stories are circulated through more informal means that often involve face-to-face conversations and meetings at specific places (e.g. the mural or the SF Tenants Union office) and events (e.g. the mural inauguration). Rather than a limitation, this form of circulation helps define a community through a process of self-selection where access is granted to those within the community or who commit to participating in an event.

Production of Subjectivity and Spatial Understanding

The oral storytelling performances (where stories were recorded and later included in the map) and the creation, unveiling, and everyday experiencing of the mural project, are events that play a role in the production of subjectivity. These are formalized spaces and times of reception of both stories and visualizations. They are intensified forms of what occurs at other times and places of reception—online, at the mural, on the phone, etc. As such they make more legible the ways in which an assemblage of enunciation is part of the production of subjectivity. These are processes that frame and reproduce the relationship between individual and community, and resident and neighbourhood or city. The assemblage is comprised of a heterogeneous collectivity of humans, events, spaces, devices, words, images, facts, stories, etc. The organizing principle in this particular assemblage is the *mapping* in the *Anti-Eviction Mapping Project*.

From mapping evictions to showing patterns in transportation to interviewing survivors to creating oral history maps to hosting storytelling events to producing community-led murals, the diverse activities of the *AEMP* have shown that mapping is a term that means more than placing markers on a two-dimensional representation of a territory. I suggest that the *AEMP* works closer to a model of *critical visualization practice*. *AEMP* is a form of practice in that it instantiates an assemblage of enunciation aimed at resistance to and survival of gentrification and displacement. It is akin to Eades and Zheng's (2014) notion of a counter-mapping assemblage that attempts to bring together a heterogeneous network of people, objects, events, and places into a collectivity that tells a different story about a specific area.

Eades and Zheng (2014) note that "mapping is thus the process of producing and reproducing 'a spatial understanding' of a part of the world" (p. 81). In this general definition it is necessary to also include the use of graphic artifacts, systems, processes, and performances—especially in how they are used to connect with others. Eades and Zheng (2014) point to DeLanda's formulation that relations of exteriority are essential to how assemblages co-exist and interact with other assemblages (p. 90); specifically, they use this formulation to understand how a variety of platforms including publications and online mapping services are used by the Wemindji First Nation to relate their perspective to settler society and other Indigenous communities.

Similarly, the *AEMP* works as an assemblage of people, messages, devices, places, events, images, words, and voices to resist displacement. It centres its activities around the notion of the map—partially because it began as a simple representation of the crisis. More importantly, the *AEMP* has continued mapping the stories, experiences, and facts of displacement on a history of San Francisco. In doing so, it has built an assemblage of enunciation that attempts to resist through the act of creating a different possible world. This is a world built through components that not only represent another world but enact it. And through its enactment, an alternative production of subjectivity is instantiated.

Conclusion

I consider both Forensic Architecture's *Liquid Traces* and the *Anti-Eviction Mapping Project* to be examples of critical visualization practice. While *AEMP* works to solidify a

community and represent the issues it faces to allies, corporations, and government, Forensic Architecture visualizes evidence such that humans and objects get to speak within forums where cases of human rights are decided.

The challenge here has been to understand an artifact or object like the *Liquid Traces* visualization less as a representation and more as a network or assemblage. On the one hand, networks help us analyze the ways that evidence is ordered into a stabilized arrangement. On the other hand, assemblages help us understand it as a creative practice that produces subjectivity. The *AEMP* project illustrates how visualizations can work as processes, in an assemblage, that can take on different forms of expression that strengthen and proliferate the connections with other assemblages.

This overview of the two projects demonstrates the suitability of using Latour's framework as a starting point to understand a larger picture of visualization practice but it also reveals the limits of that framework. Assemblage theory and specifically enunciation/expression was explored in order to extend the ways that a network-cum-assemblage can be used to look at critical visualization practice. In the next chapter, my own research-creation project will be discussed with use of this framework. People, technologies, networks, and physical sites are coordinated in this critical visualization project so that the nature of the relationships amongst participants is acknowledged, the form in which humans are represented is scrutinized, and the aesthetic and affective potential of the visualization is explored. The review of this project will also include a critique of the results and will point to alternatives that may improve the overall project.

Chapter Five: Critical Visualization Practice

Introduction

> "Everyday, one of my street family is dying because of this cold weather," Tabitha Turk, who has lived on the streets of Toronto for 15 years, said at the vigil. "Nobody [cares] about us out here. They treat us like we're invisible." (Otis, 2015)

The case study that forms the subject of this chapter is a project entitled *In the Air, Tonight* (*ITAT*) (2013–). I co-created *ITAT* with Dave Colangelo along with a growing number of collaborators. It combines media architecture, environmental sensing, social networks, visualization, workshops, and news media to make links between urban space, climate change, and homelessness. Its dominant visualization medium was a low-resolution array of light panels that clad Ryerson University's Image Centre building in Toronto, Canada every month of February from 2013 until present. It displayed a blue wave with occasional red or white bursts to represent local wind speed and social network traffic on the topic "#homelessness." This case study involves the application of a framework to the practice of visualization as well as an abstraction of real issues of poverty, justice, life, and death, through an aesthetic project that aims to increase visibility and understanding. The stakes in this project are high and yet the effects are diffuse and difficult to quantify.

Through an analysis of my own participation in this research-creation project this chapter makes the case that there is a clear line of logic through Latour's definition of design to visualization to actor-networks to assemblages to critical visualization practice. The value of this

endeavour lies not only in analyzing artistic or activist visualization projects such as *Liquid Traces*, *Anti-Eviction Mapping Project*, and the present project but also in looking at how visualizations more generally are themselves both networks and assemblages that contribute to the production of subjectivity. I believe this is an important task and valuable contribution to how we understand the process of visualization, but there is work to be done in order to shift the discourse to include an expanded notion of design and visualization practice. This is evidenced by my recent experience in attempting to present this notion within a scholarly forum through a case study of the research-creation project that will be discussed in this chapter.

An analysis of this project was also submitted to the IEEE Visap 2014 conference in Paris.[31] This conference is one of the most prestigious and long running international academic and industrial events in visualization, although the specific track to which I submitted the project, Vis Arts Program, was only in its second year. It was submitted for consideration in two categories: exhibitions and paper presentations. It was rejected in the former and conditionally accepted in the latter. The comments offered by the peer reviewers are illuminating with respect to the expectations within the visualization research community, how visualization process is delimited, and to a lesser extent how art practice, aesthetics, and visualization are currently being practiced and studied. For instance, one reviewer stated that the project

> as a visual communication, speaking to the homelessness in the area, the elements are conceptually disjointed and rely upon verbal explanation to order [sic] to access the purpose of the work. Visual art is a means of visual communication. Visualization is a

31 IEEE (Institute of Electrical and Electronics Engineers) is one of the world's largest technical professional associations; see https://www.ieee.org/.

> means of visual communication. When it relies so heavily on verbal explanation one has to ask why it is presented in this format. (IEEE, personal communication, August 7, 2014)

Other reviewers commented that the visualization was of minimal quality and simplistic due to both the simplicity of the variables used and presumably the low resolution of the display (on the building). These comments reiterate a persistent and dominant outlook in visualization practice, i.e. that even when framed as art, visualizations are purpose-built to communicate complex data in more simplified form to facilitate a cognitive task and promote a specific action. A strong commitment to communication and representationalism seems to be at the root of this evaluation. It relies on a paradigm of communication (e.g. Shannon and Weaver) that prioritizes correspondence, efficiency, clarity, and speed. The project's success hinges on the visualization (image) object efficiently representing something, rather than on the network or assemblage that emerges. This is a position that emphasizes the *visualization-as-artifact* instead of *visualization-as-process*, *visualization-as-event*, or *visualization-as-assemblage*. The following discussion works to problematize this supposition.

The IEEE reviewers failed to see the relevance of the non-visual parts of the visualization. To be sure, a central challenge is delimiting the space that constitutes the visualization—in other words distinguishing what is part of the visualization from what is not. The elements typically considered to be part of the visualization are the visual representation, the visual style, the graphic conventions, the software, and the interactive features. We can extend this to include the cognitive load, the perception science, the usability, and the task performance. In the former list, the surface characteristics of the visualization are considered, and in the latter, the human

performance is evaluated. Consideration of these elements delimits a space that is very much focused on the artifact and its immediate effects. This is a comfortable problem domain in which data can be collected, taxonomies can be built, and standards can be applied in the pursuit of efficiency and efficacy. The other more difficult elements that are involved in the visualization process are who and what is assembled, and in what way. This requires attention to the way data is gathered, how connections between one visualization and another are made, and how participants/actants are enlisted.

My experience of receiving this feedback became an impetus for including this project as a case with which to think through critical visualization practice. Building off the analysis offered in the previous chapter, here I will further make the case that if visualizations are to be considered more than discreet artifacts we must employ the concepts of network and assemblage to create more robust and useful accounts of how they operate.

Visualizing Weather and Homelessness

At base, the visual design of the *In the Air, Tonight* (*ITAT*) visualization can be thought of as a kind of weather beacon[32] placed on the LED façade of the Ryerson Image Centre. A simple sweeping blue animation represented wind speed (sweep speed equals wind speed). The direction of the sweep (sweeping left or right) represented the direction of the wind. The wind

32 This was also inspired by the Canada Life Building weather beacon; built in the 1950s, it announces weather changes through a series of simple lighting changes (e.g. lights on the support tower illuminate in an upward direction for temperature rising, downward for temperature falling, and a light on the top of the beacon flashes red for rain and white for snow) (Desson, 2014).

direction was derived from a compass on our weather station[33] from which we got data in degrees (i.e. 0 degrees equals north and 180 degrees equals south). If the wind crossed 180 degrees we changed the direction of the animation. We chose this number since the main face of the Image Arts building, which faces the pond/ice rink (a central feature of Ryerson University's downtown Toronto campus) and therefore attracts the majority of pedestrian traffic, runs north to south and would reflect the direction of the wind appropriately. This constant animation was intermittently disrupted by a pulse of colour that represented either a tweet containing the hashtag #homelessness or the moment when someone donated to the project.

The visualization was extremely simple in order to take advantage of the particular characteristics of the physical space and LED façade. Given the low resolution of the façade, more complex layers of information would simply have become confusing and difficult to correlate to a particular datum. This apparent limitation worked to our advantage as it allowed us to simultaneously relate and distinguish the two sides of the natural with the social, namely wind speed and temperature with social communication and homelessness, via the colours blue (for wind) and red (for #homelessness) or white (for donation).

The choice of colours also helped reinforce the legibility and presence of the project. For instance, the blue gradient acted as a symbol of the project by connecting the building with a mobile website and desktop website as well as all the other visual elements (e.g. collateral material) involved. Blue became a visual extension of the building to create an external/dispersed network of screens for the installation—beyond the physical building and onto mobile/desktop

33 We purchased a consumer-grade weather station for this project and installed it on the roof of the Ryerson Image Arts building in order to get local sensor data.

devices. The other colours were reserved for intermittent use. The red pulse acted as a warning or signal of concern while the white pulse acted as a brief reprieve or illumination.

The visualization of wind speed, direction, and Twitter activity took place on the building as well as on the mobile devices of viewers on-site and web users off-site. This meant that visitors experienced the scale of the building's animation: the immensity of the red or white signal combined with smaller, scattered experiences of signals on smaller screens in the immediate vicinity. The changing colours in the large-scale LED light installation reflected off the environment (e.g. windows, ice, snow, concrete), creating an immersive experience that was at once aesthetic, specular, and embodied (see Figure 11).

Figure 11. ITAT installation at Ryerson Image Centre by P. Davila and D. Colangelo (2016).

The building acted as a central beacon both physically in the city and visually in a set of interfaces offered to participants—the blue, red, and white animation tied together the visuals as displayed on the building and the mobile/desktop website. Its centrality was also reinforced by the fact that the site of the Ryerson Image Centre is also geographically at the centre of the highest concentration of facilities and services for people experiencing homelessness in Toronto. The beacon was also expanded through the interaction that existed both onsite, where users directly responded to the physical experience of affecting the animations on the building, and also in a dispersed manner, where users could browse, tweet, and retweet across the city, and especially in drop-in centres.[34]

Apart from creating cohesion between the different media that the project existed on, the visual language was kept intentionally minimal in order to emphasize certain aspects of the project. For instance, the design of the web application (i.e. website) was focused on representing the flow of tweets that contained the hashtag and visually emphasized the activity and energy surrounding the topic—visualizing the global concern represented through Twitter conversations. Also, the design of the web application also encouraged users to compose their own messages about homelessness as well as retweet any especially salient tweets that already existed in the stream. Finally, the information bar on the top of the web application also is a visual representation (iconic and textual) that further connects situational information and the experience(s) of homelessness at the site of the Ryerson Image Centre, delivering live weather

34 We made efforts to reach out to the local community by distributing information about the project to drop-in centres and homeless shelters around the city. Each of these centres has Internet-enabled computers, and by the end of the project we had seen some participation from clients and staff at these centres.

data and allowing participants to connect that with the hardship and risk of actual cold weather conditions at that very moment.

While those who experience homelessness[35] come from all walks of life, and may be young, old, male, female, LGBTQ, and/or may experience health issues both mental and physical, what all people experiencing homelessness suffer from is overexposure to the elements. This is one of the underlying dangers that threatens a life that has been stripped bare of its most basic supporting element: shelter. It is because of this underlying and crucial fact that we decided to stage *ITAT* in the middle of the winter—a time in Toronto, and in many places around the world, when shelter becomes even more important for those who find themselves without it.[36]

Coincidentally, the winter of the first year of the *ITAT* project was also one of the coldest winters Toronto had experienced in over 30 years. In the period between November 2013 and April 2014 there were 36 days that warranted Extreme Cold Weather Alerts (City of Toronto, 2016). This was a significant jump from previous years when the average number of alerts had been 13.6 per winter.[37] In winter 2014–2015 (the second year of the *ITAT* project) the number of days of extreme cold rose to 39 which further increased the risk for people living on the street—several people died in the cold on this particular year.

35 Homelessness can be broken down into a series of general categories which outline issues that are particular to certain vulnerable populations including youth, women, Indigenous peoples, the elderly, and people with addictions or mental health issues. Often, someone experiencing homelessness will fit within more than one category.

36 Another dangerous time of year is the height of summer when people with complex health issues suffer more and risk death when temperatures rise.

37 Although climate scientists observe that there is very likely a trend towards fewer cold days and more warm days (IPCC, 2007) there is also climate research that suggests that more extreme cold weather could result from a reduction in sea ice (Petoukhov & Semenov, 2010) and Arctic warming (Francis & Vavrus, 2012).

The *ITAT* visualization, specifically the interface of the LED façade and the web application interface, reflects this focus on the threat from the elements. But this part of the visualization project constitutes one rather simple artifact that creates a direct representation of the data that drives it, i.e. wind data, tweet data, and donation data. On another level, the *ITAT* visualization assemblage operates as multiple components (e.g. maps, workshops, walks) that go beyond direct representations of data.

Beyond Communication and Representation

To include the wider entanglements of visualization beyond the artifact also requires that we expand upon what is understood as the role of visualization beyond its communicative properties to encompass the performative aspects, non-linear capacities, and heterogeneous networks at play. I suggest that *ITAT* constitutes a particular form of art, design, and visualization practice that attempts to step beyond a concern of representationalism, communication, formal aesthetics, problem-solving, or augmenting cognitive processes—all dominant notions within the visual design of information and visualization. I also posit that this project serves as a modest example of a *critical visualization practice*, that is, a form of visualization that acknowledges and fosters a critical understanding of the complex processes of translation, representation, and participation involved in any form of visualization.

As evidenced throughout this text, I have relied on a collection of scholarship based on (and including) Deleuze and Guattari's concepts associated with assemblages to expand upon Latour's material semiotic approach to visualization. Latour's notes on design, although much

less developed than his actor-network concepts, do provide a very useful context in which to consider his work on visualization—especially for the critical designer.

In the previous chapter, I discussed how two different visualization projects worked as critical visualization projects precisely because they both, to varying degrees, attended to the connections that formed their respective assemblages. In this chapter, I will continue that basis of analysis for my research-creation project, but it is important to also consider one of the contexts in which this visualization project is situated—namely, visualization as communicational practice.

The comments cited from the peer-review of my conference paper show an indebtedness (albeit unacknowledged) to Shannon and Weaver's (1964) communication model and more precisely Board's (2011) map-communication-model. This is symptomatic of a larger dominant paradigm in HCI and information visualization that is committed to increasing efficiency, augmenting cognition, and establishing core principles of visualization.[38] If we are to question information visualization as a form of communication we must interrogate the notion of information within communication. In this respect, Terranova's (2004) analysis of communication as a process within networks helps us quite a bit. Information is not a content of communication, according to Terranova. Instead, information is the process by which possibilities are controlled and resistance is performed. It does not follow a logic of representation where establishing difference and identity are the foremost concern.

38 This is not to suggest that there are no alternative discourses within these fields. Areas such as affective computing, critical design, speculative design, and social computing have launched ambitious projects to focus on critical theory, marginalized knowledges and communities which may often entail a critique of communication and representation.

Terranova uses the foundations of information theory to understand communication and representation in a networked society. Drawing from concepts in thermodynamics and statistical mechanics, information theory holds that the relationship between states is nonlinear and our understanding of these states is determined through probability. Terranova notes that

> This has a double consequence for our understanding of the cultural politics of information: on the one hand, it implies a shift away from representation to modulation which emphasizes the power of the mutating and divergent; on the other hand, it locates informational dynamics outside the perspectival and three-dimensional space of modernity and within an immersive, multidimensional and transformative topology. (Terranova, 2004, p. 28)

We can apply this notion and see how communication rendered in a network has more to do with transformation and mediation than correspondence. Both Latour's networks and Deleuze and Guattari's assemblages share this concept. Accurate accounts of a network's construction, according to Latour (2005b), depend on acknowledging how mediators transform meaning and not just transport it (p. 40). Assemblages of enunciation can produce different forms of expression that are connected but do not necessarily resemble their forms of content. In this respect communication and expression may seem to be opposed to each other. Where communication may purport to establish a basic channel for transmitting meaning, expression is more concerned with the proliferation of meanings and forms.

Terranova outlines a logic of communication in a networked era that precisely lies outside of a notion of correspondence and linearity and instead centres around a notion of potentiality or possibility. She suggests that "What lies beyond the possible and the real is thus the openness of

the virtual, of the invention and the fluctuation, of what cannot be planned or even thought in advance, of what has no real permanence but only reverberations" (Terranova, 2004, p. 27).[39] Applied to the design of visualization, we can say that the pragmatics and the performance of the assemblage necessitate different forms because of the variability of contexts, media, and materiality—despite any intentionality on the part of the designer.

The rethinking of communication entails a rethinking of representation. If an adherence to correspondence is tempered with an acknowledgement of mutation, mediation, or transformation, then the possibility of faithful representation is also problematized. Mediators are key members in actant networks because they do not transport meaning from one actant to another but rather translate meaning. Furthermore, as discussed in the previous chapter with respect to the *Liquid Traces* visualization project, Latour's navigational approach to the role of visualizations involves negotiation and emphasizes the agency of the navigator rather than the correspondence of the map to territory—this approach thus weakens the mimetic importance of a visualization.

As discussed in previous chapters, Pickles has identified the crisis of representation in mapping to be rooted in a scepticism towards the grounds of objectivism, a rise in subjectivity in mapping, and an analysis of the ideological underpinnings of maps. His critique is launched at the communicational model of scientific cartography and is contrasted with the power-knowledge model of critical cartography. While Pickles, to address this crisis, recommends we start by thinking of mapping as a social creation that employs representational strategies, Latour

39 This would complicate the conventional aim of design which lies in the planning of action to create a desired outcome.

asks us to consider it as a strongly formed network of agencies—a form of social assemblage that attaches human actants and technical actants to each other. Contra the correspondence model of visualization, it is through a network or assemblage model of visualization that the navigational, non-representational, and performative processes make it valuable, useful, or productive.

Critical Visualization Practice as Expressive Cartography

The reframing of communication and representation beyond the notion of correspondence also leads us to reframe information within visualization. A critical engagement with visualization practice opens the door to evaluating what is in fact produced by this mode of visual practice. I suggest that one way of thinking about critical visualization practice is to consider it as a form of *expressive cartography*.

As discussed earlier, expression allows us to think of the nonlinearity of outcomes of a process. We can go back to the etymological components of the term "expression" to remind us of the process of pressing out or the movement from one form to another form or series of forms. This is the important component of expression that allows for the non-linear and non-causal relationship between forms and ultimately the proliferation or emergence of multiple forms. Expression, and especially enunciation, signal the importance of the performative, contingent, and material dimensions.

Rather than referring exclusively to geospatial information visualization, I use the term cartography to refer to two other key aspects of information visualization practice. First, cartography refers to the way that data is mapped onto the terms or context of other data in most,

if not all, instances of visualization (Cox, 2006; Manovich, 2002). Second, cartography references the fact that visualizations, in particular the kind that can be termed artistic or aesthetic (Fishwick, 2006; Gaviria, 2008; Sack, 2007; Viegas & Wattenberg, 2007), function as maps that arrange information, images, etc., which produce a multitude of subjective readings and connections beyond the original intentions of the designer or artist.

This line of conceptualizing an expressive cartography is indebted, in part, to the rhizomatic structure proposed by Deleuze and Guattari. The image of the rhizome suggests the logic of connectivity in an assemblage; as Deleuze and Guattari (2004) state, "a rhizome ceaselessly establishes connections between semiotic chains, organizations of power, and circumstances relative to the arts, sciences and social struggles" (p. 7). Rhizomatic structures spread horizontally and are distinguished from what Deleuze and Guattari call arborescent hierarchical structures, which are vertical. These two divergent concepts can be understood through the notion of mapping versus tracing. On the one hand, rhizomatic maps introduce assemblies, connections, networks, and recombinations, while, on the other hand, traces slavishly reproduce a given event or object in order to provide an indexical relation to an original moment. Mutation and creation are emphasized in the former while provenance and authority are privileged in the latter.

In a certain way the term expressive cartography is redundant because both parts of the term indicate a similar logic. First, expression is non-linear articulation that acknowledges the multiplicity of forms that may manifest. Second, cartography is a kind of creative mapping that assembles connections between concepts to create new planes. Both are in contradistinction to the idea of tracing where a form is reproduced without change, and therefore both emphasize the

possibility for creative change. Despite this apparent redundancy there is value in thinking of them as complementary terms because of the emphasis on enunciation on the part of the former term and on assemblage on the part of the latter.

The expressive aspect of visualization also highlights the contextualized action that takes place—the enunciation in the assemblage. Therefore, an important aspect that should be noted in this conceptualization is the emphasis on information visualization as a practice. This subtle yet significant shift is an acknowledgement of the performative dimension of visualization. The use of the term performance, in this context, is meant to highlight the labour involved in creating visualizations, the constructed nature of visualizations, and the use of visualizations. This is an analysis that has already been made with regards to maps. Pickles (2004), for instance, states that "Maps are made because of the needs of particular social situations; they are made to fulfil a particular function. As a result there cannot be a general theory of mapping and cartography, only a pragmatics of map-making and map-using" (p. 66). So rather than focus on the veridical characteristics of a visualization, the focus is put on the imbrication of social and technical processes. Visualizations, in other words, are always in a state of becoming. This emphasis is necessary to understand visualization projects such as *Liquid Traces*, *Anti-Eviction Mapping Project*, and especially a project like *ITAT*.

While making and using maps, as Pickles suggests, are important aspects of the action that takes place in an assemblage, we should expand this analysis to also look at how visualizations are part of actant networks and are constructed, supported, reiterated, and expressed through the constitutive processes of those networks. Again, expression helps us understand the multiplicity involved in visualization. The expressiveness of a visualization is a product of it being a part of

an assemblage. It arranges material in ways that can be expressed through a multitude of allied forms.

Thinking of information visualization practice with regards to the specific medium of architectural façades emphasizes the focus on expressivity, and networks of production and reception in a visualization project. Part of this is due to the physical scale of the visual medium that, on the one hand, requires specialized technology, negotiation with property managers, and permits, and on the other hand uses physical public space and interactive mobile interfaces. Using a building façade to express meaning with moving image and light is a genre of art practiced by numerous artists and designers that works with these ideas of scale, visibility, public space, and interaction.

This project was influenced by the work of several artists that have used large projections and displays to offer critiques and/or create relational spaces. These include Rafael Lozano-Hemmer, Jenny Holzer, Alfredo Jaar, and Krzysztof Wodiczko. In particular, Jaar's project for Montreal's *Mois De La Photo*, *Lights in the* City (1999) informed the *ITAT* project. *Lights in the City* asked clients of downtown homeless shelters in the city to press buttons which, in turn, triggered red lights in the Cupola of the Marché Bonsecours (Jaar, 2000). Jaar's project is laden with an overriding symbolic layer relating to crisis or disaster—the colour red with its near universal (yet not exclusive) association with risk or danger and the cupola with its history of fires that have destroyed the building. Jaar merges participation, symbolism, and visualization in order to communicate a strong feeling and message about the everyday crisis of homelessness.

Jaar's project serves as a useful contrast to the *In the Air, Tonight* project. *Lights in the City* can be understood as creating a correspondence between the people using a homeless shelter and

public announcement of the issue. This works primarily on the premise of representation. The presence of people experiencing homelessness is augmented in the minds of viewers but there is nevertheless a direct correspondence between a button pressed and a signal emitted. The veridical value of the red signal is based on its indexical connection to the person who enters the shelter. Proof of the crisis is demonstrated and thus concludes the project.

On the other hand, *ITAT* can be understood as creating an event that takes place over a duration in which several people/objects are assembled. Here we return to the notion of expression, which helps us understand how the relationship between what is visualized and how it comes into being is a complex creative relationship that is in constant interaction with its context. As Brian Massumi states,

> It is important not to think of the creativity of expression as if it brought something into being from nothing. There is no tabula rasa of expression. It always takes place in a cluttered world. Its field of emergence is strewn with the after-effects of events past, already-formed subjects and objects and the two-pronged systems of capture (of content and expression, bodies and words) regulating their interaction: nets aplenty. (Massumi, 2002b, p. xxix)

Expression is therefore as much an entanglement as it is a manifestation. Massumi (with Deleuze and Guattari) suggests that we remove the causal and communicative function of expression in order to understand the formation of social arrangements, law, culture, architecture, technology, etc. When applied to an artifact/process such as aesthetic visualization we can consider that where a communication goal would seek to create a correspondence between a sender and a receiver, an expressive goal would understand the creative movement between one

thing and the next thing—never settling too long in one form or another. The expressive is nothing if not emergent—the form of which is most surely to shift over time.

As described above, the *ITAT* project, beyond the representation of environmental variables and social network traffic, found expression through a variety of visualizations (e.g. on the façade, in videos and animated gifs, and on maps) as well as a variety of media including architecture, mobile phones, desktop computers, homeless shelters, Twitter, social justice walks, local news media (including the weather report), and art and design online media. This diffusion and creation of a discursive field surrounding this public visualization project was the originally stated goal and therefore warrants an expanded notion of visualization to fully account for the conception, execution, and circulation involved in this project. When one includes these various aspects in the understanding of visualization one may be forced to consider visualization as a process but also as an event. Massumi (2002b) reminds us that "expression is an event" (p. xvii) in order to emphasize the process, the movement, and above all the constant change and mutation that is involved.

The Network and Assemblage of In the Air, Tonight

A designer or design team needs to attend to a whole host of components that in themselves constitute the process that leads to the visualization of data, especially when it is presented in an digital and interactive form. These components involve protocols, systems, software, interoperability, communication, data, hardware devices, as well as graphic conventions and usability. This amounts to a network or assemblage that is composed of human

and nonhuman actants. But the critical visualization designer needs to attend to more than the usability and technical requirements of a visualization, they need to attend to the ethical dimension of how well or how badly humans and nonhumans are arranged.

The *In the Air, Tonight* project represents such a network and assemblage. *ITAT* arranges nonhumans including the wind, the temperature, the sensors, the light emitting diodes (LED), the building, the application programming interfaces (API), the Twitter platform, and several programming languages (e.g. Java/Processing, Javascript, PHP), as well as humans including the people experiencing homelessness, the workshop participants, the activists, the politicians, the Twitter users, the designers, and the researchers into an assemblage that simultaneously stabilizes the meanings and locations of homelessness, and creates multiple expressions that connect to other assemblages.

A list of all the components in the assemblage or project reads somewhat like a laundry list of disconnected projects but it is through the careful repetition of specific elements, the timely coordination of events, and strategic sharing of allied visualizations that this project emerges as an assemblage. Not unlike the *Anti-Eviction Mapping Project*, the conceit of *ITAT* is to visualize a specific issue in an effort to resist, support, or at the very least create a better understanding. To this conceit a multitude of allied projects are attached. But this also frustrates a definitive description of the project. The obvious choice for *ITAT* is to settle on the visualization displayed on the Ryerson Image Centre façade even if this may misrepresent the connectedness and complexity of the project.

At base the project consists of: a building-sized visualization and web interface that visualizes weather data and Twitter activity around #homelessness; a photovoice workshop held

at St. Michael's Hospital; a series of online visualization videos describing spatial aspects of homelessness; news articles in the Huffington Post; a PR campaign to garner media attention and news stories; an interactive documentary installation. The project also connected with an ongoing Social Justice Walk conducted in the area that coincided with the duration of the installation. What this list implies is the variety of expressions that a given issue may produce and the dynamic of how these assemblages operates. Yet it all centres around the notion of visualizing an issue.

As an initial step to connect *ITAT* with other assemblages, we identified some key stakeholders early on in our research and discovered that information dissemination and sharing by this group of experts and practitioners was occurring online in the form of an ongoing Twitter conversation organized under the hashtag #homelessness. Leading up to the initial launch of *ITAT*'s month-long run, we reached out to this community, informed them of our project, and asked them to help us amplify this issue and their ongoing efforts by continuing to spread information about the project. Reaching out to this community had two major effects: it increased the frequency of the hashtag in online discourse, creating a small but important change in the online media diet of some Twitter users, and it encouraged connections to be made between these experts and practitioners, helping them to deepen connections between countries and sites across the mostly English-speaking world (i.e. U.K., Australia, U.S.A., Canada).[40]

The effort to connect with a community of key stakeholders led to connecting with initiatives already taking place in the local community. Although an independent project, Cathy

40 This was a limitation of using an English hashtag but subsequent iterations include equivalents in other languages.

Crowe's Social Justice Walks are a good place to start in order to look the ways that *ITAT* works as a network-assemblage and through expressive elements. By its very nature as an independent project it illustrates the ways that assemblages attach to other assemblages through relations of exteriority. All year round, housing advocate and street nurse Cathy Crowe[41] leads walks throughout the downtown Toronto area in order to sensitize people to the realities and complexities of homelessness. The four week duration of the *ITAT* project also overlapped with Crowe's ongoing series of tours. During the month of February 2014, Crowe's walks often began in front of the installation at Ryerson University, where issues raised by the project were incorporated into the discussion. Crowe described and discussed aspects of *ITAT* with the attendees, who were also encouraged to participate in the project by tweeting about the issues raised through the proceeding walk. While the walks conducted by Crowe are independent of the *ITAT* project and pre-date the creation of the project, they form part of an assemblage that arranges and connects issues of justice, visibility, news media, and engagement.

These walks work like allied inscriptions where the *ITAT* project is a preceding inscription in the network. The walks reproduce and transform part of the visualization into other media forms. They also strengthen the value of the visualization created by the *ITAT* building installation. But again, the inscription metaphor is an odd fit with the way that the walk expresses content in the project. In order to extend the analysis we must look at how it emerges through the assemblage.

41 Crowe is Distinguished Visiting Practitioner, Department of Politics and Public Administration at Ryerson University. She also leads the Jack Layton Leadership School: Social Justice, Activism and Community.

If we recall the mapping-assemblage suggested by Eades and Zheng (described in the previous chapter) we will see a similarity in how spatial issues are recreated, reinterpreted, and performed through walking and visualization. A spatial understanding is produced through walking-as-mapping. While the visualization on the building and the project maps shared on Twitter deterritorialize the assemblage through information networks, the visualization is territorialized through the walk. These are the two extremes of one of the axes of the assemblage described by DeLanda (2006, p. 11). Terms are either deterritorialized through dissemination and distribution or they are territorialized and concretized through their performance by specific people in a defined physical space and context. For example, on one walk, Crowe led the group from the *ITAT* installation at Ryerson University to a social housing complex, and then on to a shelter threatened with closure, a wintertime warming centre, a community health centre, and finally to a shelter on the periphery of a social housing redevelopment (see Figure 12). Nearly three hours in duration, the 2.5 km walk made a point of showing the distances—which were made more arduous by the -20 C weather—between services that a person experiencing homelessness needs to access.[42] The group performed a map on the territory containing the shelters, the services, the *ITAT* installation, and a large number of people experiencing homelessness.

42 A map of the walk can be accessed at: https://www.google.com/maps/d/viewer?mid=z0TQlQTTYo60.k6a19bJnzLKA.

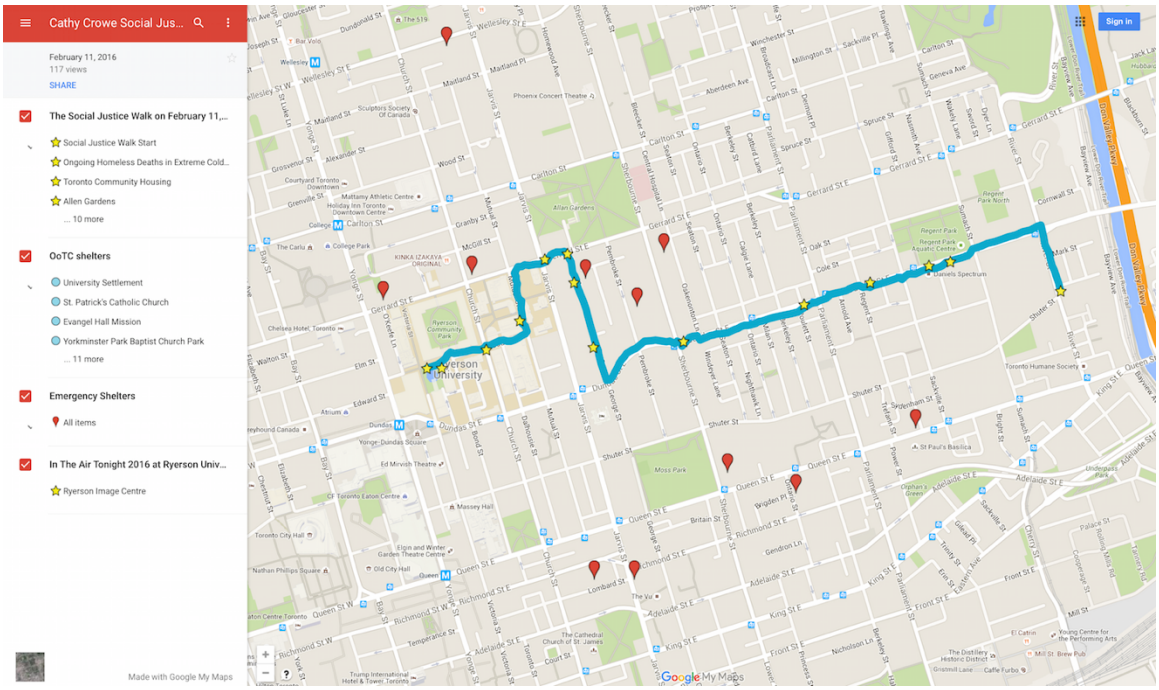

Figure 12. Map of Cathy Crowe's *Social Justice Walk* (screen capture), part of *ITAT* by P. Davila and D. Colangelo (2016).

The *ITAT* assemblage connects with Cathy Crowe's walks which represent another assemblage emerging from her academic position at Ryerson University, her involvement in street health, and her ongoing participation with social services in the city. Despite the performances differing, the Social Justice Walk is attached to the *ITAT* assemblage through a process of sharing material and expressive components. The *exteriority of relations* described by DeLanda (2006) as well as Eades and Zheng (2014) is a key feature of assemblages that allows them to proliferate, join, or mutate. The association with Crowe's walk is similar to that which *ITAT* has with other assemblages, for instance the #homelessness hashtag itself that exists as an organizing principle for all tweets regarding the topic. Similar to Crowe's walks, both the hashtag and Twitter itself pre-date *ITAT* and work independently from the project, yet they get

attached through the proliferation of expressions and functions that occur through the *ITAT* project.

The *ITAT* web app interface, which mimics the visualization on the building in real time, is also entirely devoted to tweeting and thus connecting to another assemblage. The interface enables users to read and write tweets even if they don't have a Twitter account. The Twitter feed on the interface is curated to only show tweets tagged with #homelessness. It is a minimal interface with very few other elements (see Figure 13). Furthermore, we use the hashtag to show all posts, articles, and visualizations that get created or shared by the project. Again, the *ITAT* assemblage attaches itself to another assemblage through its ability to differently express similar material components (i.e. data, people, weather).

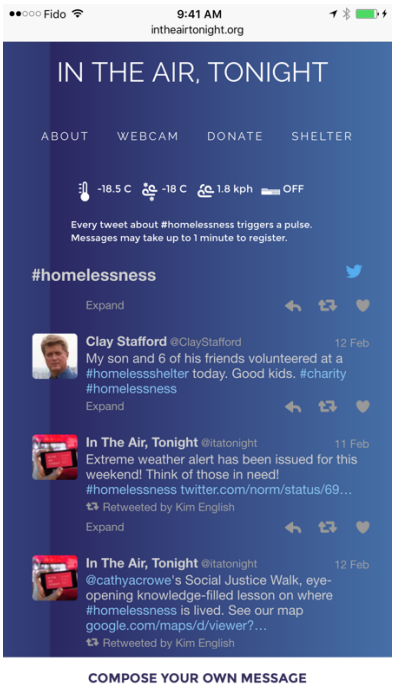

Figure 13. Mobile interface (screen capture), part of *ITAT* by P. Davila and D. Colangelo (2016).

It should be underscored that the *ITAT* installation is located in downtown Toronto, where, as mentioned above, the Ryerson Image Centre's geographic position puts it in the middle of a cluster of several homeless shelters and drop-in centres for people who are poor, homeless, and chronically under-housed[43] (see Figure 14).[44] This spatial arrangement of these services is also expressed through the Shelter mobile-ready web app we developed as part of *ITAT*. Designed to help people quickly find drop-in centres, Shelter augments the existing online offerings of the Toronto Drop-in Network (TDIN) by adding a mobile-ready interface and providing route recommendations which guide the user to drop-ins from their current location (see Figure 15). The Shelter web app prototype was soft-launched this year in order to gauge interest and solicit feedback from users and people working on homelessness. We are exploring a more developed visualization/wayfinding web app with the general manager of the TDIN and with city councillors who've demonstrated a commitment to making services more accessible to the city's most vulnerable populations.

43 It is also two blocks away from the Church of the Holy Trinity where the Toronto Homeless Memorial is held every month. People gather on the steps of the church, and the names of people who died while homeless are read out loud and attendees are invited to share stories about them.

44 A map of the area and locations can be accessed at: https://www.google.com/maps/d/viewer?mid=z0TQlQTTYo60.khsWV4lEOrFg.

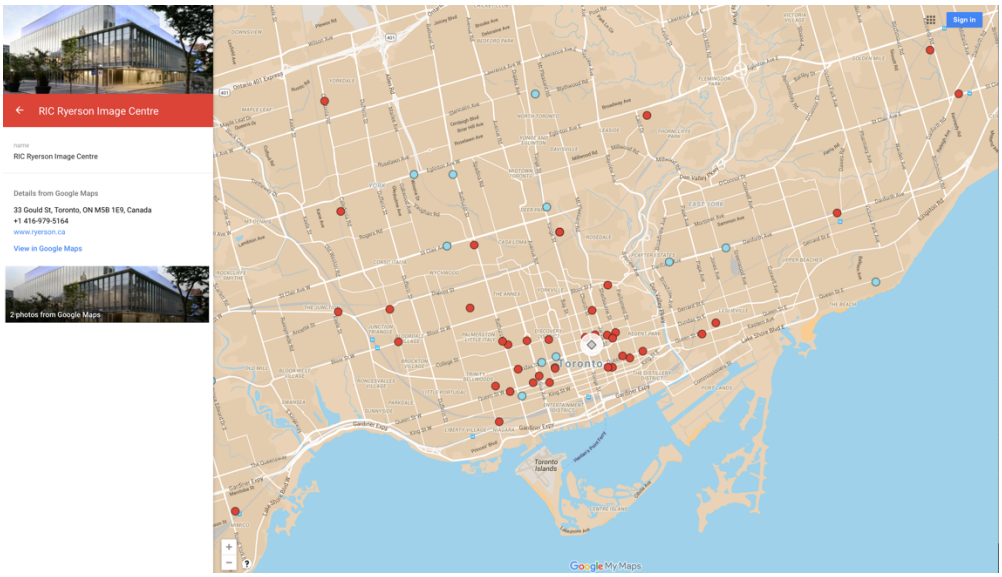

Figure 14. Map of *ITAT* location (at Ryerson Image Centre) in relation to shelters and services.

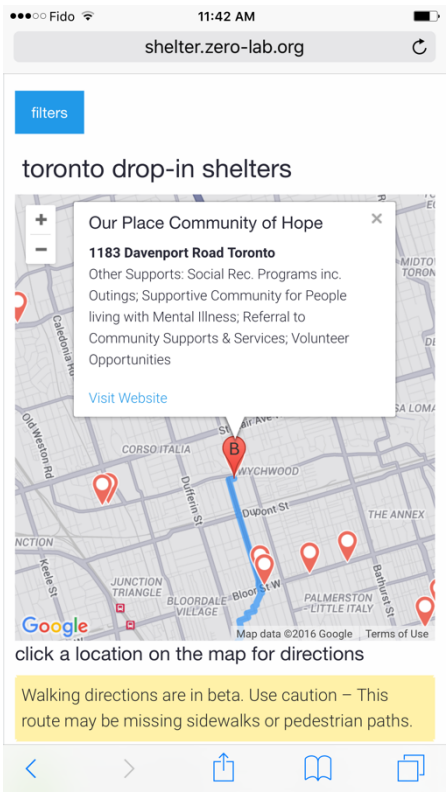

Figure 15. Shelter app (screen capture), part of *ITAT* by P. Davila and D. Colangelo (2016).

Admittedly, the visualization of weather and Twitter activity on the Ryerson Image Centre building is very simple but this is both by design and out of necessity. At once, it relies on the spectacle of the lit building and the colours it casts on the surrounding area as well as adapts to the constraints of the architecture of the building and technology of the lighting system. In this way the building installation acts as a hub through which these projects, objects, and processes are linked.

For instance, this year (2016) we added a workshop component to the *ITAT* project. Tim McLeod and Alexis Mavrogiannis, collaborators in the *ITAT* project, led a series of workshops at the Supporting Transitions and Recovery (STAR) Learning Centre at St. Michael's hospital in downtown Toronto. Participants, who included people transitioning from living on the street to living in permanent housing, were invited to photograph parts of the city and parts of their everyday experience that they thought would be important to document and share with others. Equipped with disposable cameras, participants documented places and objects in the city that had particular significance for them—for example a site where a friend had died, a symbol of hope, or a symbol of political inertia. Comments were written on selected images that elaborated on participants' choices of subject. A collection of these images and comments were edited together and geo-located on an online map that was made available through *ITAT* using the #homelessness hashtag (see Figure 16).[45]

45 A map of the images can be accessed at: http://publicvisualizationstudio.co/photovoice/.

Figure 16. Map and geo-located photos from STAR photovoice workshop (screen capture), part of *ITAT* by P. Davila and D. Colangelo (2016).

A comparison of the different visualizations will reveal that they all show the same thing—namely, downtown Toronto, social services, and homelessness. Although their visual style is not intentionally similar we can see that they are referring to the same places and the same issue. While the *Anti-Eviction Mapping Project* made use of the same styles for different visualizations, the *ITAT* project focused on one space using a variety of visual styles.

Two visualizations were developed for the most recent iteration of the project (see Figures 17 and 18).[46] These were based on the work of health sociologist Kristy Buccieri (2013) who researched the movements of several young people experiencing homelessness in the Toronto

46 The visualizations can be accessed at: https://www.youtube.com/watch?v=imRmTMwmsPU and https://www.youtube.com/watch?v=H_Vb82yY_ZA.

area. These were designed as very short narratives that would describe one or two aspects of experiencing homelessness—namely, the daily routine and travel required to get to services. Two styles of presentation were used: a fly-through visualization through different locations in a 3D rendered city and a static overview showing different journeys. Each style fostered a different experience of the space and the data. The fly-through visualization, used for the daily routine visualization, attempted to give a more micro perspective on the spatial aspects of experiencing homeless and accessing services. Flying from location to location from a point of view of approximately 100 ft. above the ground allowed the viewer to see the shape of streets, the green spaces, and possibly familiar buildings that would ground the experience. The static overview, used for the required travel visualization, retained the visual qualities of the satellite imagery from which it was created, and allowed for a more macro view of the city. The view's lack of movement promoted the idea that this was a stable (and transcendent) Apollonian gaze.

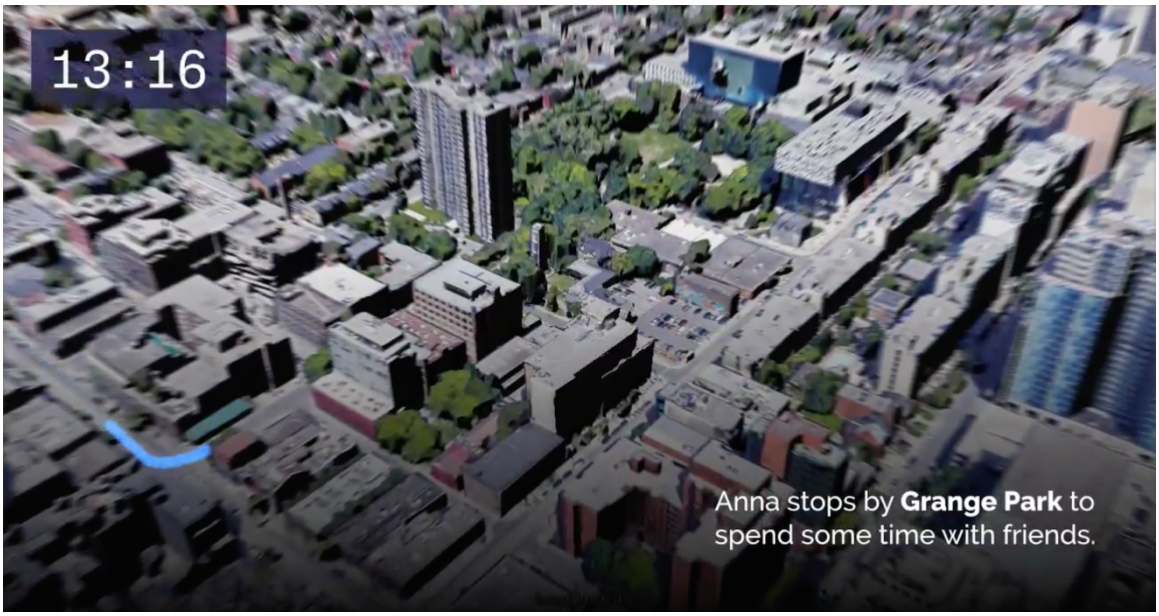

Figure 17. Fly-through visualization (screen capture) of the movements of youth experiencing homelessness, part of *ITAT* by P. Davila and D. Colangelo (2016).

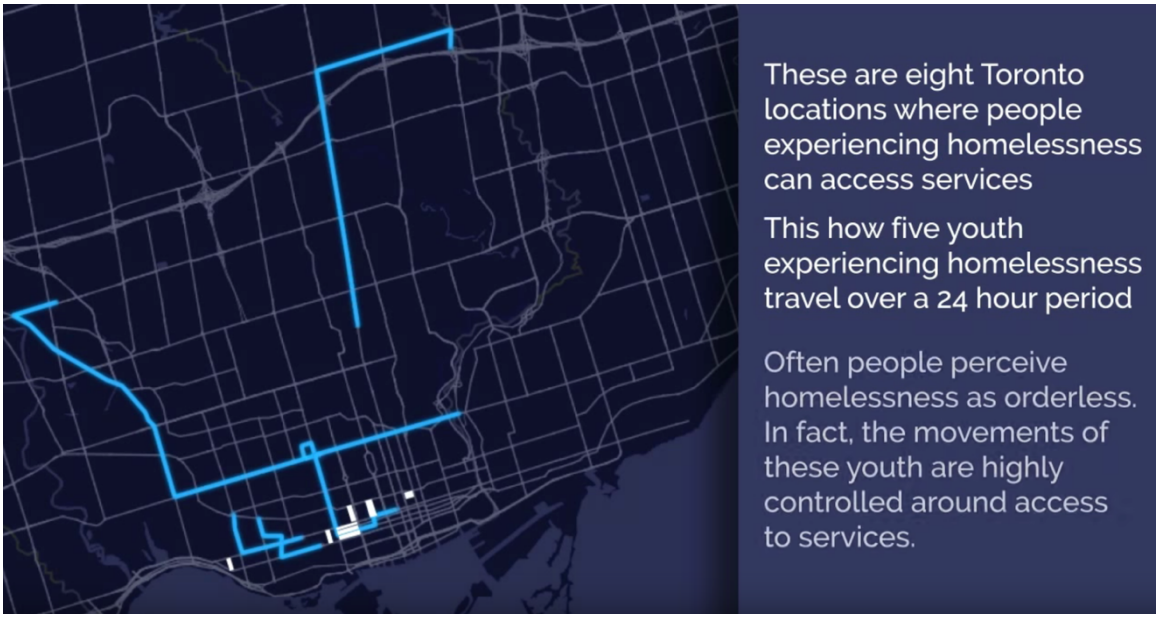

Figure 18. Overview visualization (screen capture) of the movements of youth experiencing homelessness, part of *ITAT* by P. Davila and D. Colangelo (2016).

The visualizations are designed to be viewed, posted, and embedded in a Twitter or Facebook feed where users often have videos play automatically as they scroll through. This tactic is similar to that employed by news organizations (e.g. Propublica, AJ+, Mic, Salon) that make extensive use of social networks. For instance, Propublica uses a specific file format (animated .gif files) to communicate short intense bursts of information relating to a news story. Because of the limitations of time and the constraints of file format these are often visualizations designed specifically to attract the user's attention and deliver a very succinct message. These animations often link to longer news stories that go into much greater depth. Part of the tactic is to create a compelling visual story using data that can be easily distributed (e.g. re-tweeted or shared on Facebook) and thus increase the potential readership of the article or of the news agency more generally.

Although these visualizations do not represent weather and social network activity, they are imbricated into the visualization project in order to attach themselves to the assemblage and show another dimension of the issue. The original visualizations created by Buccieri for her research report (see Figure 19) were re-designed, animated, and annotated. In this way, they added to the cascade of inscriptions surrounding the research on spatial agency and homelessness. They build on the work done by the sociologist by inserting it into another assemblage. While in a cascade of inscriptions (e.g. visualizations), for Latour, an individual inscription increases its scientific value through its association with previous and allied inscriptions, in the case of these visualizations they increase the expressive dimension. Not unlike the maps produced around the *Anti-Eviction Mapping Project*, these visualizations proliferate through their treatment and styling by designers working on the project. In order to

increase the audience, these visualizations express the specialized data from the original report in forms that address a non-expert viewer.

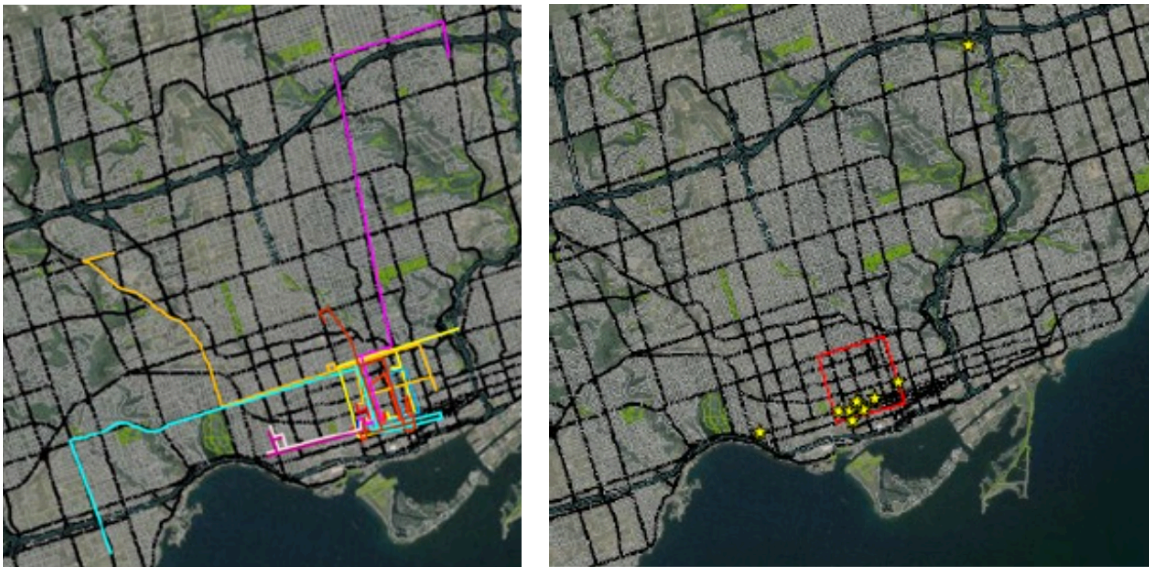

Figure 19. Original movement visualizations from Buccieri (2013).

Participation and Interessement

If a visualization is to be understood through the lens of network and assemblage then how members act within this arrangement is an important consideration. Being part of a network and working to maintain a network are both forms of participation. Again, this produces a challenge for analyzing visualizations. The processes and forms of participation have been generally limited to quantifiable aspects that involve software, tasks, and visual cognition. This is not surprising because, as discussed in previous chapters, one of the explicit goals of information visualization is the reduction of complexity in the aims of augmenting human cognition and pattern recognition (Bederson & Shneiderman, 2003)—which precisely delimited an area of research and innovation.

The *ITAT* project may represent a reversal of this putative role of visualization where instead the complexity is posited on the interpretive and participatory side rather than on the interactive and representational side of understanding data. This is potentially another factor that led to the conflicting reviews of the project by the IEEE peer reviewers. Using a very low resolution matrix (i.e. the building LED façade) and a very simple mapping of data to visual elements, this project combines and visualizes three streams of data (i.e. wind speed, wind direction, and Twitter activity). These are rather simple data sets but it is their juxtaposition and their arrangement with other participatory aspects that invites more complex interpretations and implications. This kind of project—where there is a shared medium (e.g. building facade, Twitter feed) and where visitors and viewers can alter the artwork through specific actions—highlights the way participation and sociality largely produce the aesthetic experience.

But we should be cautious not to conflate the ability to affect a visualization through the use of an interface (i.e. interaction) with the notion of participation. While interaction, within the context of visualization, normally refers to the process of human-computer interaction (HCI), participation must be understood as a process that: first, does not directly require mediation through a computer; second, acknowledges that feedback is not a matter measured in milliseconds but can be a much more complex and delayed process; third, does not necessarily aim to augment specific cognitive processes; and fourth, in many cases, entails a political commitment that aims to produce more equitable relationships amongst participants or between participants and the outcome of a project.

For the purposes of the present study the focus is primarily on the participatory aspects of the project. Although interaction is an important consideration of the work of visualizations, a

look at participation allows us to note how a network and assemblage is produced. This becomes even clearer when we consider that an emphasis on interaction would become increasingly difficult if we were to log all the various ways that interfaces may manifest and specific issues of interaction and cognition emerge within a networked notion of visualization.[47] The emphasis on participation as the work that constitutes the network is also supported by Latour's (1986) stress on looking at the role of how objects (i.e. inscriptions) are assembled or how things are drawn together (p. 6) rather than the role of cognition in visualization when trying to understand the ways that knowledge is created and transported.

Immutable mobiles allow information to travel back and get assembled with other inscriptions. Cascades of inscription form a series of claims that strengthen through their imbrication. Navigational practice characterizes the way that users consult calculation surfaces that collect and present a variety of data. These are forms of transporting and working with information but they also involve a form of enlisting actants into a network which, in turn, becomes an actant within another network. We saw how this occurred in the two case studies discussed in the previous chapter where the network process of interessement was used as a concept to understand how participants were represented in a visualization project.

To further our use of this concept we can also look to how the *boundary object* as a form of interessement operates in a project like *ITAT*. A boundary object (e.g. image, document, device, system) makes possible the coming together of various stakeholders around a common issue

47 It should be noted that there are fields which do focus on this kind of research with networks such as Computer Supported Collaborative Work (CSCW). But a vast majority of work in visualization tends to focus on specific problems illustrated by specific types of visualizations, interactions, etc.

(Star & Griesemer, 1989). Each stakeholder agrees to the more general components of this representation but finds specific components within the representation which suit his/her particular agenda. The strength of this concept comes from the fact that it describes specific instances in socio-technical systems which act as translators between various stakeholder groups without the need to create consensus. People can share, use, and contribute to some kind of representation of a given issue and agree to its main features but find more precise features that relate to their personal goals. In other words, a visualization can be a common ground without requiring everyone to agree to exactly what it means or represents.

Star and Greisemer outline a variety of types of boundary objects that match some of the aspects of the *ITAT* assemblage: repositories, ideal types, coincident boundaries, and standardized forms. Repositories allow participants to withdraw things from a collection (e.g. objects, data) and repurpose them for their own uses. Ideal types allow participants to share a common visual representation that is abstract enough that it does not contradict individual understandings of an issue. Coincident boundaries allow participants to view different contents of a similarly delimited space. Standardized forms allow participants to use a common interface to communicate despite being from different social worlds. Therefore, if applied to the *ITAT* assemblage, boundary objects can be in the form of visualizations (i.e. coincident boundaries or ideal types), social media platforms (i.e. standardized forms), or archives (i.e. repositories) which allow people who inhabit different social worlds to interact with a common space (Star & Griesemer, 1989, p. 411).

For the purposes of this discussion it is useful to think of the activists, designers, users, passersby, media, viewers, etc. as party to the boundary object. Rather than rely on a polysemous

or subjective reading approach to understanding how this visualization project functions, the boundary object can help model the way that a network of actants may participate in the life of a project. It is not necessary for all users, viewers, designers, activists, researchers, etc. to see the exact same thing in the visualization. In fact, the power of a visualization may rest in its ability to be vague enough that people may invest in a particular representation of data to the extent that they can agree on the general contours of the issue being represented. In the case of *ITAT*, we can think of the association of weather and homelessness through the (aesthetic) boundary object. Interessement through the form of the boundary object can address the way that visual engagement can proceed. But once again, as we saw in the case of the *Liquid Traces* project and the *Anti-Eviction Mapping Project*, the notion of interessement, as a network process, should be considered in parallel with the assemblage in order for it to be more useful for *artistic visualization* projects.

As discussed previously with these visualization projects, applying Latour and Callon's concept of interessement (Callon, 1986; Latour & Callon, 1981) to critical visualization practice limits its utility to focusing more on how power relations are centralized to create authority through the translating of participants into an actant-network. Through obligatory points of passage, power is centralized in the manager or researcher. Through *problematizing* an issue, the manager or researcher becomes indispensable. Enrolment and mobilization bring participants into the network and transport issues to a wider network, a process that can stifle dissent from participants. However, the model of the boundary object addresses part of this limitation by modifying the concept to emphasize an ecological analysis of how concerns around a given issue are mediated and represented (Star & Griesemer, 1989, p. 389). That is to say, it does not hold

any point of view as primary, essential, and more valid than any other. In this way, it points to how objects themselves can be collaborative devices that perform interessement and translation in a network, but it does not necessarily work to centralize the management of power.

Understanding visualization through an ecological (i.e. boundary object) framing of interessement is necessary to a critical visualization practice and therefore for understanding the way the network is constituted, and the way its members participate and each makes use of the resources of the network. This modification is important because it opens up the way translation is a more distributed process, which can also help in creating assemblages that do not shift authority to a central figure (e.g. artist, designer, manager, researcher).

It is also instructive to compare participation in a visualization project, as an artistic project, with how participation is framed within relational aesthetics projects in order to address potential critiques of this kind of practice. Relational aesthetics is an umbrella term used to describe a variety of art practices (e.g. the work of Joseph Beuys, Liam Gillick, and Rirkrit Tiravanija) that aim at creating spaces in which social interaction is fostered. The artwork generally requires participation and people doing things (e.g. making and eating pad thai) in a given space in the hopes that a sense of conviviality and dialogue would emerge (Bourriaud, 2002, p. 30). Yet, relational aesthetics projects can suffer from the same reductionist and centralizing effects identified in interessement, where an artist enlists community participants in order to complete the work—a work that will, through documentation, reviews, etc, continue to circulate in an art economy well beyond the social world of the participants. This comparison also helps us consider some of the critiques of this genre of art practice (as well as other forms of site-specific and community-based art practice) and use this to critique the role of interessement,

beyond the notion of the boundary object, in a project like *ITAT*. The political ambitions of relational aesthetics have been vigorously critiqued to be, at best, ineffective, navel-gazing, elitist exercises masquerading as socially-engaged art, or at worst, parasitic practices that import authenticity by using local communities (Bishop, 2004). Similarly, site-specific artwork (which sometimes coincides with relational work, especially when the site is construed as a community) has also been critiqued for exacerbating power inequality, remarginalizing constituents, and depoliticizing issues (Kwon, 2002).

This remarginalization through reproducing power inequality can go hand-in-hand with the importation of authenticity. This is analogous to the inherent critique within interessement advanced by Callon and Latour. Networks of actants can be stabilized to form a larger actant that incorporates the voices, bodies, and performances of human and nonhuman actants—this is a form of power. In the *ITAT* project, we brought in the lived experiences, the visual stories, the supportive tweets and shares, and the data in order to create an actant that would (temporarily) represent homelessness. We therefore also ran the risk of re-creating a power dynamic that could further marginalize the people we were attempting to represent.

Attempts at producing a better assemblage have been made throughout the course of the three installations (i.e. 2014, 2015, 2016) but two initiatives are particularly instructive. First, in 2015, we were inspired by the *Tweets2Rue*[48] project in France that provided phones and accounts to several people experiencing homelessness, to assist them in telling their stories. This is part of a larger trend in social media to tell stories (e.g. documentaries, histories, first-person accounts)

48 See http://tweets2rue.blogspot.ca/.

through a long series of short posts that can last from a few days to much longer. The aim of the project was to humanize street-involved people and dispel misconceptions of homelessness. Through *ITAT* we attempted to begin a similar project that would allow people to tweet their own experiences in Toronto. With the help of coordinators at one of the Out of the Cold shelters in downtown Toronto we were put into contact with a client who was interested in participating as a correspondent. He was identified as a good candidate because he was in transition to permanent housing and expressed interest in the project itself.

The concept was designed to have the correspondent tweet his reflections and report on the current conditions at the shelter he was using. In addition to enriching the Twitter discussion about #homelessness, these specific tweets would produce different colour animations on the building and therefore add to the variables being juxtaposed on the visualization. We proceeded to secure an honorarium, purchase a phone (that he would keep after the project was concluded) as well as a usage plan for one month, and set up a Twitter account through which he could publish his posts.

Although the project started out well it ultimately failed. The participant's phone was stolen a few days after he took possession of it—a reality in the shelter experience that we failed to adequately prepare for. In addition, we lost touch with the participant and were unable to follow up for debriefing and for feedback on how to improve the project. This failure signals a lack of adequate attention to how certain parts of the *ITAT* assemblage were constructed. Even if this process did not directly remarginalize the participant, the value of the initiative for him was negligible at best. Had this project been successful there may have been a better experience for

the participant where he would have been able to address a wider audience with his reflections and reporting.

This initiative was rethought for the following year's iteration. Instead of enlisting one or two people and asking them to report through tweets, we used a framework that was already in place and which already had some trust in the community. As described above, Tim McLeod and Alexis Mavragiannis, both graduate students focusing on public heath, led a series of workshops at St. Michael's Hospital Supporting Transitions and Recovery (STAR) Learning Centre in Toronto. Using photovoice[49] methods, the workshops allowed participants to build confidence in personal storytelling through photography.

The photos created by workshop participants detailed both the daily lived experience of homelessness and personal reflections on political factors contributing to the ongoing crisis. Images were selected and annotated with captions that helped readers interpret their content. These images were also geolocated and positioned on a map of the downtown area in order to again show the spatial dimension of experiencing homelessness. This map, in turn, was distributed through tweets from the *ITAT* Twitter account including the #homelessness hashtag.

Although this was a much more successful iteration of our attempt to include the voices of people experiencing homelessness, there were still issues with regards to maintaining the links between the members of the assemblage. While the workshop participants were able to view their photos, select ones they liked, and annotate them, they had little or no opportunity to see them assembled, disseminated online, or visualized on a map. Part of this problem stems from

49 Photovoice is an auto-ethnographic research method that positions the participant's agency at the centre of the process. It is popular in research projects that study experiences and conditions of marginalized communities.

the inherent difficulty in continuity in a limited amount of time with someone who does not have housing, but it also stems from a lack of fully accommodating how participants can continue benefiting from their involvement in the project—in other words, how participation as interessement is maintained in ways that do not exacerbate existing power dynamics.

The feedback on the *ITAT* project from reviewers for the IEEE Vis Art symposium generally identified a failure to communicate efficiently. But I believe the failure lies somewhere else. It does not concern the communicative properties of the visualization but rather the nature of how the assemblage was composed and maintained. The failure was in the lack of a deeper engagement with the people who experience homelessness. Although it was through researchers, advocates, and support workers that we have gained knowledge or moved forward with the project, engaging with people personally affected by homelessness has been a much more difficult process. Power, privilege, and lack of personal connections have contributed to this particular failure. The assemblage that was instantiated through this project did not sufficiently attend to the connections made between the participants. This is a factor that may contribute to the difficulty in maintaining connections to the community when an event such as *ITAT* is held once a year and its main participants do not form part of the community during the rest of the year. The value of this kind of visualization project increases by the degree with which it maintains the assemblage. A sparse and anemic network renders the visual components of the visualization spurious at best or willfully misleading at worst. If this project is to be held to the criteria of a critical visualization practice then it should do much better at addressing this issue.

Conclusion

The difficulty in thinking about visualization as a process is that it can involve aspects that are common to any number of other non-visual processes (e.g. organizational management, community services, editorial roles). It is at this point when we expand the scope of what is considered in the analysis that the question emerges, are we still dealing with visualization or are we dealing with an expanded media practice? Critical visualization practice is an expanded media practice because it takes as a central apparatus the visualization of data but does not subscribe to the notion that a simple artifact is created. Instead, it allows visualization as a process to move beyond strict definitions and allows sources to participate in ways that are not limited to a logic of extraction. The *ITAT* project was a public aesthetic visualization installation that knew itself to be also an expanded media and critical visualization project. The various aspects of the project were designed in order to foster activities and interactions that could take place. It was a specific kind of installation using a specific understanding of what is meant by visualization. Nevertheless, there are elements in this installation that hold true for most if not all instances of visualization, namely assembly, representation, and interpretation. As an assemblage, visualization is constructed by enlisting technologies and humans, then circulated through expressions of these components which are received, interpreted, and further reiterated through other assemblages. As critical visualization practitioners, designers and artists should emphasize the ethical relationship—which often gets scant attention—between these elements.

Chapter Six: Conclusion

Prometheus is a figure that represents a daringness to catapult the state of things far forward. He also represents a dynamic where the instruments of great change are bestowed upon everyday people by heroes and geniuses. Design has often been framed within this trope. For instance, Nelson and Stolterman (2012), in an attempt to create an ontology of design, suggest that humans did not discover fire but that they did design it. In this aphorism, humans, particularly adventurous and clever humans, take on the role of Prometheus. It speaks, at once, of the ingenuity of human designers to shape even the most elemental components of life, as well as the ubiquity of design process and its fundamental role in supporting human life. In a similar vein, acclaimed modernist designer Paul Rand (2008) stated that "Everything is design! Everything!" (p. 25). Design being everywhere means that its product is embedded in everyday practice and that designers affect everything. These statements betray a certain hubris in the ability of design to affect all corners of life. They easily fit into a kind of practice that leads the charge forward to design the world—to press idealized diagrams onto a receptive medium.

This is in contrast to Latour's (2008a) employment of the term where instead, he presents the "cautious Prometheus," a modest driver of change, in an attempt to temper this hubris that historically has had its most powerful expression in industrial science and technology.[50] Modesty points to the logic that must be used to address the massive scale of environmental, social,

50 Ezio Manzini (1992) echoes this ethos when he suggests that we should embrace the "Prometheus of the everyday" by which he means there are quotidian design challenges all around that our attention should be directed to forming better connections in a variety of local ecologies (p. 5).

economic, and technological issues we currently face that have resulted from unbridled industrial and market forces. This is key to working through a mode of restyling and reconfiguration rather than grand reversals or giant leaps forward. For Latour, this also entails a rethinking of the critical stance—moving from an approach that seeks to denounce and unveil a truth to an approach that seeks to describe and evaluate the quality of constructions (i.e. socio-technical).

Visualization plays a very important role in this postcritical approach. It is a genre of media practice that assembles data in order to describe and make visible phenomena that escape immediate apprehension. Visualization, communication design, information design, and interaction design are concentrations of technologies and techniques that work at the intersection of human knowledge, perception, action, networked media, and computation. They are a set of disciplines that represent a basis through which to investigate the schism between representationalism and postrepresentationalism, between a linguistic paradigm and a performative paradigm, and between a critical and postcritical approach.

This situation led to the development of a guiding research question that looked at critical visualization practice. In order to understand how visualization can operate as a critical design practice that simultaneously attends to the representational and performative processes it arranges, this study articulated a theoretical framework that could describe relevant characteristics of that practice and looked at three case studies that engaged in that practice. This entailed also looking at how visualizations work as assemblages that arrange people and things. The way(s) that subjectivity is produced within these human-nonhuman assemblages also emerged as an important consideration.

The process of addressing this question has led to a novel investigation and articulation of visualization design practice through actor-network and assemblage theory. Visualization design was considered as an expanded practice that entails the configuration of networks and not just the immediate visual medium or the analysis of data. This was aided by the linking of methodological analysis in ANT and theoretical concepts in assemblage theory to create a more flexible framework. This framework helped both create accounts of how visualizations function and formulate speculations of how they produced subjectivity. This work thus broadens the scope of what is considered visualization. Without disavowing the study of visualization that pursues a semiotics of symbols, a heuristics of interaction, and a metric of perception and cognition, this study has shown how knowledge is reproduced through visual means, but also how this production depends on the maintenance of specific relations.

In a visualization project like *Liquid Traces* it becomes clear that visualization practice involves a process of assembling and relating diverse data components onto a plane that allows for inspection. This process assembles human as well as nonhuman actants in order to be flattened out, compiled, and compared. Satellite imagery, news reports, simulations, and interviewees were composed into a dashboard that afforded the viewer an instrument through which to navigate a narrative of refugee deaths. This project exemplified how inscriptions travel and form cascades which accrue authority and persuasiveness, and yet show their constructedness. The equipment in the assemblage was made evident through the interface of the dashboard. Video clips, inventories, and maps were composed on the screen. The cascades of inscriptions were made visible. The viewer also saw the equipment show its seams and provenance of representations through the layering of raw images over and under refined

diagrams. The visualization also involved other relations by being attached to other assemblages where equipment was configured for data collection. Interviews with a survivor were conducted to corroborate other sources already collected. Memory was supported through writing, photos, and the presence of a clergyman. These assemblages of collection attached to visualization assemblages also transformed survivors into expert witnesses. Their representation in the visualization and associated reports and videos, which aided the legal case against the NATO governments, recast these few illegal migrants as authoritative voices. This example points to how this kind of project has effects that far outstrip the immediate visual-perceptual effects of the display.

Similarly, *Anti-Eviction Mapping Project* shows how in a visualization assemblage the configuration extends far beyond one surface. The mapping project uses the conceit of a map that makes the displacement of tenants in downtown San Francisco visible but it also creates a cartography of artefacts, events, experiences, and places that produces a subjectivity that resists displacement. Although the case study focused only on a handful of maps created by the project it is evident that these maps proliferate as immutable mobiles and, more importantly, as mutable mobiles that are restyled and recast. In some instances, data remained the same and maps were animated and captioned, in others the visual style was reused for different data but for the same issue. The assemblage extended and attached to other assemblages of organizations, networks, and locations. Again, like *Liquid Traces*, *AEMP* assembled human actants through its data collection process (e.g. oral storytelling events, online forms). Participation also defined the way this project created relations between the storytellers, tenants, advocates, and designers. Places

were marked with maps and portraits of participants/community members and online maps placed their voices amongst other markers that described a quantitative measure of displacement.

One of the results of *In the Air, Tonight* was a multiplying of the ways a visualization assemblage could exist and move. Another cartography of elements was produced by walking the territory, plotting the waypoints, making a site-specific intervention, adding donations, conducting a workshop, and appearing in news media. Assemblages attach to other assemblages through an exteriority of relations. Linkages are made between assemblages because of shared content and mutability of expressive forms—a walk is a map, a map is visualization showing services, a mobile app showing shelter services is also an interface to make donations, donations trigger building-scale visualizations, building visualizations appear on news stories. This project, along with the previous two case studies, also represents the modesty emphasized in constructing multiple versions, iterations, and connections to other assemblages. They also underline the need to maintain the connections made as a matter of ethics in a critical visualization practice. What becomes apparent through these projects is that representing (our) entanglement is also a form of entanglement.

These projects are all involved in establishing, perhaps designing, a matter of concern—the guilt of NATO forces, the violence of displacement, or the crisis of homelessness. Matters of concern do not exist without participation, interessement, and the construction of assemblages. Design, especially in the form of visualization, is therefore involved in creating the style of our attachment, the kind of equipment we use, and the conditions of our artificiality. The environments, the tools, and the processes that comprise our spheres also shape our ways of perceiving our spaces and ourselves. Visualization, as a practice that acts as a prosthetic and

augmentation of our abilities to perceive the world, is a powerful actor in this sphere. Yet our attachments are of a cognitive as well as a participatory character. This is derived from Latour's recasting of design as a way of understanding how things are connected, which embeds visualization into design practice precisely because of its ability to "draw things together."

The decision to incorporate Deleuze and Guattari's work was driven by an observation of the similarities between networks and assemblages in how each described their respective objects of thought. This was observed while still acknowledging the differences, namely that networks, in the form articulated in actor-network theory, are part of a methodological discourse, and assemblages, in the form articulated by Deleuze and Guattari, are part of a philosophical exploration. Assemblage theory, like ANT, acknowledges a form of agency in nonhuman actants which is essential for an ecological understanding of phenomena. This also leads to an understanding of subjectivity as a production that involves human and nonhuman affects—a notion which Latour echoes with the concept of equipment. It was Lazzarato's work on asignifying semiotics, through Deleuze and Guattari, that was particularly helpful in making links to how visualization could involve proto-subjective processes. While Latour's methodology emphasizes the traceable processes, Deleuze and Guattari's theory emphasizes the mappable connections and thus makes it possible to elaborate a theory of subjectivity that can incorporate notions of proto-enunciation or possibly pre-attentive cognition into the analysis.

The development of this articulated framework and the analysis of these case studies has also served as a catalyst to begin new projects in exhibition, curation, research, and practice. As a guest curator at Onsite, the new professional gallery at OCAD University, I will be creating an exhibition on critical visualization practice scheduled for winter 2018. The program will include

projects that illustrate the wide spectrum of practices that work through an ethics of visualization and attachment. This often takes place within advocacy and activist work that takes guidance from the community it is representing and is accountable to. Works by Forensic Architecture, *Anti-Eviction Mapping Project*, Laura Kurgan, Bureau d'Études, Iconoclasistas, Tactical Technology Collective, Beehive Collective, and Torkwase Dyson (among others) are being considered for inclusion in the program. These designers and artists, each in their respective ways, create visualization projects that are intimately tied to the people and places represented. The exhibition of this particular mode of practice will be augmented with a symposium to allow scholars and practitioners to share current work in this domain. Community workshops will also be held in order to multiply the ways that people can access this rich history of practice as well as learn techniques that can be used in local community projects.

Recently appointed as the director of the Zero Lab at OCAD University, I will be promoting the mandate of the lab which focuses on sustainable futures, community resilience, and environmental justice through a set of practices (e.g. interaction, interface, and visualization) that aim to make these issues visible, legible, and actionable. Visualization and especially the expanded practice described in this study will directly impact how the work of the lab is guided. For instance, practices in mapping, interface design, community engagement, design ethics, and participatory methods will be central to how projects are structured.

Based on the success of *In the Air, Tonight* and other similar projects over the past five years, I have formed Public Visualization Studio with Dave Colangelo and other collaborators. This initiative is an effort to consolidate the work under the genres of public installation, interaction, visualization, and visual storytelling. We have recently produced works at Toronto's

Nuit Blanche and Mississauga's Celebration Square that immerse viewers in public spaces with interactive visualizations simulating global ecologies and essayistic videos linking global networks of consumption as labour. These projects are representative of future explorations in merging data, narrative, and experiences in public venues.

This dissertation has also opened up a landscape of thought that Latour, Stengers, and Deleuze and Guattari have drawn from work by Whitehead, James, Dewey, and Peirce where diverse but often related notions of radical empiricism, experience, and semiotics are explored. Further research in these histories looks promising for understanding alternative trajectories of thought that have influenced many contemporary scholars in science and technology studies. This may be especially productive as a basis to think through subjectivity and experience when working further through Latour's development of a Gaia theory and Guattari's notion of the Three Ecologies. Much work on the anthropocene, as a human-caused geological phase, has begun to emerge. Work on making the anthropocene sensible or visible will therefore become a growing area of research in design and media studies.

These current and future projects, and the projects described in the case studies present a special challenge for the visualization researcher-practitioner. They illustrate a challenge to manage an apparent paradox in critical visualization practice: the power of visualization is in its capacity to compellingly represent a possible reality and to simultaneously blackbox a set of relations that discourages inquiry into its components and processes. For the visualization, the greater the capacity to visually bring to life a possible reality, the lesser the opportunity to discern the quality of its construction or the conditions of its production. This is an echo of a well-articulated critique in several fields (e.g. anthropology, ethnography, history) where

descriptions, representations, and claims have required authors to foreground or bracket their subjective position, the mode of authorship, and the limits of selected techniques in order to reassert an objective grasp on the matter being studied. In visualization, this has sometimes taken the form of transparency, showing the code or the raw data used to develop a particular representation. Through artistic visualization, some artists have made a virtue of the subjective choices and human hand in the creation of a visualization by not removing traces of production and including non-sequiturs or errors in the final work. Still other practitioners have attempted to reassert a form of correspondence between the visual representation and the community being represented through collaborative projects of crowd-sourced data or endlessly editable maps.

This apparent paradox (blackboxing and revealing assemblages) presents critical visualization practice with an opportunity to reframe criticality along lines explored in this dissertation. It requires a slip in the meaning and use of the term critical; in this vein, Stengers (2008) suggests that, rather than critique, *discernment* is needed, in her case, to build good accounts of socio-technical systems. Stengers advocates that attention be paid to caring and fostering connections rather than denouncing and critiquing. Multiplicity and contingency are valued over the purification of facts. A similar notion is expressed by Guattari (1995) when he asks, "Who speaks the truth? This is no longer the question: but how, and under what conditions can the best bring about the pragmatics of incorporeal events that will recompose a world and reinstall processual complexity?" (p. 86). In visualization practice, where an account is written or visualized, an assemblage also comes into existence through its connections. Visualization as a design practice creates the style of our attachment, arranges the kind of equipment we use, and shapes the conditions of our artificiality. Where criticality may have emphasized distance and

objectivity in order to support claims of truth, when designing (in) assemblages and networks, these virtues may be replaced by attachment and proximity. What has emerged from this study is an ethics of visualization that refocuses criticality on the potential of design to act modestly, to reveal its own construction, and to maintain the quality of attachments made.

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Appendices

Appendix A

Letter Regarding Originality of Dissertation

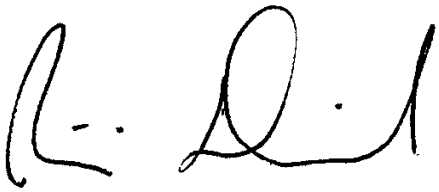
Patricio Davila

May 1, 2016

This letter describes the nature of my collaborations in the production of a research-creation project included in my dissertation, "Visualization as Assemblage: How Modesty, Ethics and Attachment Inform a Critical Design Practice," presented to York University and Ryerson University in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Program of Communication and Culture.

In The Air, Tonight (2014-) is an ongoing collaboration between myself and Dave Colangelo. Initial conceptualization and negotiations with the administration of the Ryerson Image Arts Building LED façade were made by Dave Colangelo, Jon Friis, and Takin Aghdashloo in 2011. After Friis and Aghdashloo left the project, I joined and we jointly refined the concept for the project, raised funds, and put together a team to complete the project. Colangelo was involved in initial programming, building animation design, and computer modeling. I hired and directed Robert Tu in completing the programming for the back-end of the installation (PHP, Javascript and Processing/Java) while Maggie Chan was hired to complete the building animations and produce documentation of the month-long installation. The team shared various production duties including refining the concept, installing a remote weather station on the roof of the building, installing a webcam, producing promotional materials, moderating the Twitter feed, and public relations planning and execution. In-kind consultation and support was provided by street nurse Cathy Crowe, public relations analysts Claire LaRocca and Alen Sadeh, professor and media artist David Bouchard, and the staff at the Ryerson Image Arts Building. For the second iteration of the project, David Schnitmann provided additional technical support. For the third iteration of the project, we partnered with Alexis Mavrogiannis and Tim McLeod who developed a workshop at the STAR education program.

Sincerely,



Patricio Davila

Appendix B

Re: Letter Regarding Originality of Dissertation

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June 15, 2015

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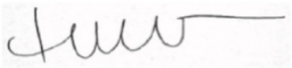
Re: Letter Regarding Originality of Dissertation

As Mr. Patricio Davila's PhD supervisor for his dissertation entitled "Visualization as Assemblage: How Modesty, Ethics and Attachment Inform a Critical Design Practice" I approve of his "Letter Regarding Originality of Dissertation" which describes the nature of the collaborations of his research-creation project.

Sincerely,



Janine Marchessault, PhD
Professor
York University