DESIGN IN THE AGE OF BIG DATA: EXAMINING THE CASE OF ONLINE EDUCATION

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by

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ABSTRACT

This work engages the question of design in an era of large scale data, focusing on the development of the values, concepts, and meanings that come about in the production of large scale systems of socio-technical interaction. Using the example of the design of massive, open, online courses (MOOCs), philosophical and interpretive methods are used to examine the nature of design, big data, and the engagement that exists between designers and users. Starting from an analysis of the work of design as it seeks to merge technological possibilities with the needs of users, the design of socio-technical systems is conceptualized as an ethical event, one which opens up the possibility of the definition of new values and concepts. Placed into the context of large scale user data, the agentive situation of the work of design is considered, with such “big human data” coming to be seen to play a central role in the determination of the products of design. In this, the concept of “peak empiricism” is developed in order to address the epistemic exhaustion that comes as increasing levels of user data is confronted in the work of design. As part of this, a new mode of conceptualizing data's role in the work of design is explicated. The specific function of the relationship between large scale user data and the work of design is demonstrated through the development of a typology of critical incidents as such incidents are found in the course data from a number of MOOCs. The implications of these findings are then leveraged toward the re-evaluation of the critical perspective put forward in Martin Heidegger's canonical analysis of the social implications of technology. Through this, established metaphysical framings for the understanding of the relation between human actors and technological systems are reformulated. Ultimately, what is put forward is a de-centered conceptualization of design as an eventful occurrence across a field of human and technological possibilities.
# TABLE OF CONTENTS

List of Tables ........................................... viii
List of Figures .......................................... ix
Acknowledgements ..................................... xii

Chapter 1. INTRODUCTION: OVERVIEW AND CENTRAL THEMES ........... 1
  Defining Design ........................................... 4
  The Status of the Artifact ................................. 7
  The Relationship between Designers and Users ............. 9
  Social Influence and Technological Change .................. 11
  Looking Toward Online Education Design .................... 16
    Opportunities and Challenges for Design in Online Education .. 18
  Looking Ahead ........................................... 20

Chapter 2. BACKGROUND: UNDERSTANDING USERS THROUGH DATA;
  PHENOMENOLOGY IN HCI ................................... 22
  Design and the Developing Understanding of Use ............. 23
  Empirical or Intuitive: Two Approaches to the Situation in Design .. 24
  Moving from the Situation of Work and on to Everything .......... 27
    Culture and Identity .................................... 28
    Values .................................................. 31
  The Epistemic Shift ....................................... 34
  Dialogue and Design ..................................... 37
    Purposes and Methods of Dialogue in Design ................. 42
    Against Dialogue ...................................... 44
  Big Data .................................................. 45
    Big Human Data ........................................ 48
  Phenomenology in HCI .................................... 50
    Theoretical Development of Phenomenology in Computing .... 52
    Methodological and Epistemological Expansion ............... 55
    Recent Uses of Phenomenology in HCI Design ................. 57
    Possibilities in Phenomenology ............................ 59
  Research Themes ......................................... 60
Chapter 3. GENERAL TECHNOLOGICAL PRACTICES: DESIGN AND THE VALUES OF EDUCATION ................................................................. 63

Understanding Design .......................................................... 66
The Social-technical Gap ...................................................... 66
The Situation of Design ....................................................... 68
The Ontology of Design ........................................................ 71
Technological Possibility .................................................... 72
Ethics and the Intention of Design ........................................ 74
Ontological Doubling of Design ............................................ 75
The Event of Design .......................................................... 76
Integration and Hospitality ................................................ 77

II: The Case of the Event of Values in Online Education .......... 80
Technology and Education .................................................. 80
General Technological Practices ........................................... 82
Categories and Values in Design ......................................... 86
Ethics and Events of Design ................................................ 89
Recommendations ............................................................ 91
Recommendations for Understanding ................................. 92
Tradition as guide, not law ................................................. 92
The undecidability of the concept ...................................... 92
Recommendations for Action .............................................. 93
The decisive nature of ethical action ................................. 93
The field that contains this action .................................... 94
Discussion ........................................................................ 94

Chapter 4. THE CONDITIONS OF PEAK EMPIRICISM IN BIG DATA AND INTERACTION DESIGN ................................................. 98
Peak Empiricism .................................................................. 101
Realism and Theory in Design ........................................... 105
The Situation of Big Data in Design .................................... 108
The Texture and Scope of the Experience of Design ............. 109
Thinking Design with Big Data (and without Empiricism) .... 113
Table 1: This table details the total numbers of registered students and the number of threads, posts, and comments made and a count of those that were coded. “Active students” refers to the number of students who accessed the course at least once. In total 218,842 posts and comments were reviewed.

Table 2: This table provides examples of the types and sub-types of critical incidents as they were represented in forum posts across the three courses studied.
LIST OF FIGURES

Figure 1. Example illustration of a critical incident: “Due to some family troubles, I am behind this week. I wanted to catch up with week 3 lessons, but i keep getting the following message: System Error We are sorry, but an error has occurred and the details of the error message is below. If this error message persists, please contact a system administrator for more details.” ................................. 183

Figure 2. Example illustration of a critical incident: “hello ( excuse my english ) so , I just dont know where i go , or what to do to submit my work , i have finished it but , I dont know where to upload , where is the button ? hahaha I AM LOST, HELP excuse my english , is very poor , and thank you.” ......................................................... 184

Figure 3. Example illustration of a critical incident: “I am a life long learner needless to list my credentials it is not important anymore... I am 62 years old mother of two adult daughters. In a few years I will retire. As a child I always liked Art and never had an opportunity to study. This is the first time I am taking a course on line and am confused with this discussion groups, assignments, deadlines and the process of postings. Could someone guide me an easy way to access the students art projects that are being produced due to the course?I love to see how others are interpreting these projects otherwise I am trying...”
to find a needle in a haystack. I don't have time to sift through with everyone's comments, threads or posts. Please help.”

Figure 4. Example illustration of a critical incident: “Hello, I'm new here, and I hope I'm posting in the right thread and I hope someone will clarify my doubt. This is my first time in the course, I was going to sign up for the may classes (because that was the only option available at the time) and It said I could start now(?) and yeah, here I am. My question is, how can I take part of the course if it's already begun? Is this a mistake, me being here? I'm sorry If I don't make myself understand, english is not my mother tongue and I hope I'm not offending anyone with this thread. Sorry and thanks”

Figure 5. Example illustration of a critical incident: “This person's attitude is unfair to the greater body of students, and may even be trolling. She condemns English speakers for being appalled at her brutal honesty, which she claims is her culture. I feel she is being disrespectful to the many other peoples and cultures on this course. Sorry to bother you with this, but there is something unsettling about this students continual attacks on English speakers and their culture.”

Figure 6. Example illustration of a critical incident: “just to make it more complicated, the first three weeks of the course coincided with the last three weeks of my time in a rural Nepal district - where internet was either very slow or non existent - made some of the course particularly
tricky - back in Melbourne now and ready to catch up (I hope)”

Figure 7. Example illustration of a critical incident: “Hi, due to internet problems in my home town (’s-Hertogenbosch, the Netherlands) I was unable to send in the Quiz of lesson 1 on time. Therefore I was a half day to late to submit them. Can you still accept and honor my submission? Also, I started the course later than the starting date, due to vacation…”

Figure 8. Example illustration of a critical incident: “I have a question concerning the due date for the Week 3 activity. The syllabus shows it as being due Sunday Jan. 26 but in the content section showing Week 3 Lesson 3 it shows the activity as being due Wednesday Jan 22. Can you please tell me the actual due date? Thank you”
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EPIGRAPH

one can only are

—Ted Berrigan
DEDICATION

For Becky and Teddy
How are we to understand the pervasive nature of technology design as it exists today? With technologies coming to play important roles in an ever-widening field of human activities, the question of technology design has come to be a central question in understanding human beings, both as individuals and as a society. Contributing to this rising importance of technology in our lives are the networked interactions made possible by the widespread adoption of Internet-connected devices and the networks that support them. The degree of connection available today has allowed applications to gain deeper and more expansive entry into people's lives, becoming entangled with not just work activities or their overt purposes, but also domestic practices, education, cultures, values, and the whole of users' experience of the world as well. In a manner which extends beyond the question of immediate, material purpose, social practices have become the object of technology design.

Alongside the deep level of integration developed by such pervasive use of technology is an analogous development concerning the relationships between designers and users. The dominant paradigm of user-centered design has expanded beyond a conception of single users and well-defined groups to include larger unstructured populations of users (Carroll, 2010; Grudin, 1990; Kamppuri, Tedre, & Tukiainen, 2006). Networked technologies allow designers to form a dialogue with their users and to design applications in an iterative fashion with their users. Through the connections made possible by the Internet, designers are able to gain insight into the practices of actual users as they engage with applications. Instead of relying on post-hoc validation of applications, designers have access to data concerning real use as it is captured as part of the system. Internet-based applications, acting more like services than traditional applications, are able to be updated and changed according to users'
behaviors and needs. In all of this, the temporal conditions of designers’ work and relationships with users undergoes a subtle transformation.

Increasingly, these relationships between designers and users come to be mediated through large sets of user data. Collected from users' interactions with a system, these modes of active and passive data collection (Amer-Yahia, Doan, Kleinberg, Koudas, & Franklin, 2010) serve to provide designers with insights about how users engage with a system, what works, and what doesn't. The increasing importance of the Internet in the use and distribution of applications allows for designers to understand users to an unprecedented degree and to build robust connections between practices of design and use.

As these connections continue to grow between users and applications, and between users and designers, any conception of use or design which seeks to defend a picture of either a solitary user or solitary designer is no longer possible. Conditions of both design and use come to be intertwined with each other and with the larger concerns of “social” interactions at large (Kling, 2007; Williams, 1996). Ordinary social interactions are becoming more technical, and technical interactions are becoming more social. Both designers and users find themselves enmeshed within a sphere of activity wider than just the immediate situations of design and use, with each able to affect the other within this wider sphere (Marcinkowski, 2013): Through their work on applications, designers are able to engage the intimate lives of users; and, conversely, users are able to exert their influence over the work of designers through both direct (through comment and suggestion) and tacit (by modeling certain modes of use to remotely-observing designers) feedback to designers.

In this, there is a question of the possibility of conceptual intelligibility that can be shared between designers and users. How do designers and users come together in order to shape a common meaning of an application whose implications are new? How does the data produced toward this building of a common understanding shape the work of design?
The conditions of design and use today are understood less as being made up of material artifacts and systems than they as being formed of both the material and immaterial social relations and behaviors of users and designers. The work of design today is to shape these relationships and understandings about the world (Norman, 2010). A design is successful not for its immediate features, but instead for the social-material coupling that it is able to achieve. More and more, for designers, the large-scale sets of data that they are able to collect about users gives them a window into the socio-material relations of their users. Such data gestures to both the immediate conditions of use as they take place in a networked environment and the wider social forms and shapes that guide that use—all this as reflexively conceived within the sets of features and negotiated intents embodied in the material construction of the systems from which the data is gathered.

The research presented here seeks to examine, map out, and theorize the conditions and processes involved in activities of technological design as they fit within a wider sphere of generalized use and action. In doing this, design will be characterized as a mode of interpretive engagement that takes place between designers and users, one which is mediated by the systems used and the data produced from that use. Given the often network-mediated relationship between designers and users that exists today, an understanding of the ways in which designers utilize user data as part of the design process is developed and the implications for a wider frame of socio-technical systems are traced out. Setting this interpretive process in a broadly hermeneutic-phenomenological light, both user data and the objects of design themselves lose any sense of atomistic particularity, and are put into constant and active engagement with the wider context of their interpretation on the part of the designer and user as they are engaged with a wider world beyond the immediacy of any application. In doing this, I seek to bring the process of design into closer contact with our understandings of use, and, following Suchman (2006), further expand the sphere of what is
to be considered in the study of human-computer interaction. Here, instead of just expanding the consideration of the conditions of use, there is an expansion of the sphere of the conditions of design. Given that much of the origin of HCI is found in research to make the work of programmers and developers easier (Carroll, 1997), this is not a far step to take. In widening the perspective on design, the consideration of what it is “to design” is expanded to include the coupling that exists with large sets of user data.

In this introduction, it is my aim to begin to lay out some of the general concerns to be addressed in this research. Toward this, I will consider the nature of design, use, and the re-framed relationship that designers and users have today. By laying out these issues, the terms of the discussion will be established so that the present nature of design in the context of large scale user data can be understood. Further, the topical setting used in this research, massive, open, online courses (MOOCs) will be discussed.

### Defining Design

Following Herbert Simon's (1969) definition of design as any course “of action aimed at changing existing situations into preferred ones” (p. 55), it has become possible to place almost any productive human activity under the general rubric of “design.” While I would certainly retain his central theme of design as relating to human effects on their environment, a more specific definition is necessary for the particular needs of the present inquiry. Susanne Bødker (1998) provides useful specificity when she defines computer design as “focusing on the parts of computer system development that are directed toward the creation of something new” (p. 108). In this, design is a generative activity that does not rely on previously decided solutions, but instead introduces new types which require a reflective approach and a reconsideration of the new territory opened up (Schön, 1992). The activity of design would not focus on the establishment of already existing systems that may alter the human situation, but would pertain to the establishment of novel arrangements of existing
systems such that the outcome of the activity has some aggregated effect which had not
previously been seen before. As will be developed later, within a phenomenological
paradigm, the work of design comes to be a form of *aletheia* which focuses on the
ontological revealing and disclosure of the world (Heidegger, 1993).

In focusing on this generative understanding of design, it is instructive to take account
of the distinction between engineering and creative design developed by Jonas Löwgren
distinguishes between engineering models of design which attempt optimal solutions to welldefined problems and creative design which seeks to provide unpredictable and new
solutions to problems that are not able to be explicitly defined. Some (particularly William
Gaver, as cited in (Wolf et al., 2006)) have drawn a distinction between the differing criteria
of success for each mode of design, with engineering-style design being judged according to
its relationship to epistemological truth, whereas creative design is judged according to its
aesthetic accomplishment. This distinction is complicated by contemporary approaches to
understanding epistemology and its relation to aesthetic truth (Bernstein, 1983; Vattimo,
1997), yet it still provides a sense of the difference in the goals (and perhaps even the worldview) associated with the different modes of design.

Design, in the sense in which it is used here, looks not to develop an optimal solution
to a defined problem, but instead to generate innovative and new approaches toward positive
goals in the manner of a true “event” (Clemens & Feltham, 2010). This sense of the eventful
nature of design speaks to the unique conditions under which such design is performed, and
the unique opportunities opened up by design, particularly if it is seen as being entangled in a
wider sphere of social and historical action. In this sense, design is never a simple re-iteration
of existent ideas, but is instead a singular instance—this whether such singularity is judged in
terms of the artifact itself, or the surrounding system in which it is embedded. In seeking to
formalize the coupling between internal and external systems, the understanding of design
developed by Simon misses, in a simplistic reading, the kind of open and eventful design
considered here. While Simon's conception is useful and necessary, understanding design as a
mode of formalization is at odds with a conception of design which, in its openness, avoids
any formal determination of possible worlds. Here, working from Bødker's definition which
seeks to distinguish "ordinary" technological accomplishment and deployment from a
different type of technological activity which she terms design, design comes to be centered
around the delivery of some extra value not previously present or known (Cockton, 2004).

A central challenge that develops when understanding design as the eventful
invention of newness comes in accounting for the possibility of the intelligibility of this
newness, both on the part of users and designers. This is, to an extent, a version of Meno’s
paradox which, as developed by Plato, questions how that which is not previously known
may come to be known. How can designers and users each come to know what kinds of
things may be newly possible? While this is a key aspect of traditional user-centered design
thinking in HCI (not just making applications easy to use, but also easy to learn (Gould &
Lewis, 1985)), the question of the introduction of new ideas about what is possible in
computing becomes more complicated as technologies come to be more pervasively
integrated into the lives of users (Chalmers & Galani, 2004). In light of the wide social
integration present in computing today, there is a task for both designers and users to
accomplish together. This is particularly seen in discussions surrounding contextual
computing, in which the onus of responsibility for the success of use is often consciously left
to the interpretive faculties of the user (Bardram & Christensen, 2007). Design becomes a
dialogue between users and designers as they each make movements toward a common
intelligibility. Each must understand the perspective of the other, with the user giving some
consideration of what a designer may provide, and designers considering how a design would
be received and enacted through its use. This sense of mutual intelligibility comes to be an
important aspect of design in the case of large-scale socio-techical systems, particular those
such as MOOCs as will be examined in detail.

Here, though design continues to focus on the central concern of bringing change to a
situation, the teleological orientation of saying that there is a particular goal which design
work approaches in an optimal (or even merely satisficing) fashion is replaced by a trajectory
that is contingent, and discovered through the joint processes of design and use. This kind of
non-teleological design is found not only in specifically creative design, but also in design
that is directed toward specific problems, as in the conception of engineering design.

Previous research into the practice of design has found a co-evolution of problem and
solution spaces in design and has described how such mutual influence lends design work a
certain air of contingency (Cross, 1997; Dorst & Cross, 2001). This picture of contingency in
design is heightened by the integration of the concerns of specific designs into a wider field
of social action in which contingent social practices are determined by related practices and
so on. Whatever social, ethical, or value-driven determinations come to influence the goals of
a design, such determinations cannot be taken for granted, as the goals of a design are
realized through the process of design itself, in a non-teleological fashion.

**The Status of the Artifact**

Beginning with the development of ubiquitous computing (Weiser, 1991), an
important insight into the nature of use was uncovered. Rather than understanding use to be
an explicit engagement with a piece of technology as a material artifact, user engagement
with ubiquitous technology came to prioritize the activity over the artifact to such a degree
that the material technology was thought to disappear almost entirely. This understanding
pushed the social and practical intent of the application well above the already high criteria
for contextual integration set by user-centered design. The use of technological artifacts
became centered around the emergent activity and effect of the technology rather than the material interaction with the artifact itself. Instead of engaging in an overt way with a piece of technology, in ubiquitous models, users are seen to engage with a task, and have the artifact disappear in a ready-to-hand fashion (Heidegger, 2010; Weiser, 1991). The artifact at hand becomes transparent in the face of the objective.

While ubiquitous computing provides the most explicit example and most extreme case of this de-materialization of the technological artifact, a similar distance from the material technological artifact is developed in social computing as well. In these cases, the main concern for users and designers is not the particular interface or technical details of any system, but the social arrangements and transformations that a system is able to bring about. The application, in these cases, comes not to reside in the material of the circuity or coding that exists in the technological artifact, but instead comes to reside in a middle, emergent space between the entities of the system and the user. It is understood as a system of effects and effectivities, but not as something that is, on its own, materially present. In these cases, the designer becomes concerned with the immaterial relations that exceed the immediate conditions of an object.

This is particularly seen in the example of the networking function of the World Wide Web. As Tim Berners-Lee (2000) put it, “[t]he web is more a social creation than a technical one. I designed it for a social effect—to help people work together—and not as a technical toy” (p. 123). The technical and material details of a design are relegated only to a supporting (yet still enabling) position. In this, the activity of design comes to take on a character similar to that given to artistic activity by Martin Heidegger (1993). In his consideration of the work of the artist, the activity of art-making is less concerned with a simple manipulation of the “thing” of the object itself, but is instead more concerned with the world-disclosing function of the piece of art that was produced. The work of design is only truly present as it engages in
a disclosive movement with the user. In the present context of computing, the work of design becomes a task of forming new social arrangements that are supported by the material states of technologies. This is something reinforced by Don Norman (2010), who, in pushing for a reconsideration of design education, highlights the “complex social and political issues” involved in design and calls for designers to not simply be concerned with the forms and materials of the physical products of their work, but to also have the skills to address “the interlocking complexities of human and social behavior, . . . behavioral sciences, technology, and business.” The work of design extends beyond the object that is made and engaged with large historical and cultural social traditions.

**The Relationship between Designers and Users**

In understanding technological artifacts as being most present not in their immediate material conditions, but rather in the forms of social arrangement and disclosure that they are involved with, it is necessary to reconsider the relationship between designers and users. Rather than seeing this relationship strictly as one of material *exchange* (in which designers provide users with technological artifacts for use), the status of the artifact becomes centered around aggregated social *relations*. That is, while remaining firmly grounded in their *thingly* character (as material), the disclosure of the truth of an artifact (as within a Heideggerian rendering of *aletheia*) is not wholly located within the artifact itself, but is produced in the relations that are established. The work of technology design is thus conceived of as a mode of social interaction in which, through their work, designers engage in social relationships with users and seek to alter these social structures and attitudes through their direct material engagements in the form of applications which are given only secondary and expedient attention. In this, a designer is only as involved with the physical material of their work as they need to be in order to affect the social and conceptual reconfigurations required. The meaning of any application cannot be understood in isolation, only when engaged with
through use. The question comes in how designers can be expected to gain insight into these conditions of use.

Following traditional conceptions of ubiquitous computing and third wave formulations of HCI theory, what comes to matter in use, beyond a basic sense of ease of use, is a deeper situational and cultural engagement (Bødker, 2006). Use expands away from the immediate conditions of the object to reflect (and be reflected in) the wider embedded conditions of the lives of users. More than just taking place within a Husserlian “Lebenswelt” as early ubicomp research had it (Dourish, 2004b), use has expanded beyond a holistic concern for the present conditions of use, to include and be supported by wider cultural practices, habits, and norms, all of which need to be approached interpretively by both designers and users (Harrison, Sengers, & Tatar, 2011).

In light of this change of emphasis in computing, designers face difficult questions concerning how to understand users. They face pressures to both understand their users more deeply (Bell, Brooke, Churchill, & Paulos, 2003), in widening situations of dynamic and mobile use (Blom, Chipchase, & Lehikoinen, 2005), and to expand their consideration of users to even include bystanders and those not directly engaged in use yet still affected by the applications that they design (Ferneley & Light, 2006, 2008). As the reach of computing extends (Grudin, 1990; Kamppuri et al., 2006), the understanding of the user becomes in many ways more opaque. As Internet-based distribution of applications becomes prevalent, designers are no longer able to say with certainty under what exact conditions their applications are going to be used or know the breadth of users who may possibly use their application. Applications are able to be accessed and utilized by types of users and for uses never imagined by the designer. As the conditions of possible use grow, so must necessarily the concerns of the designer. While the difficulties faced by designers today in gaining insight into users do present obstacles that obfuscate the conditions of use, the kinds of
technological developments (in pervasive computing, the Internet, etc.) that present these obstacles also offer a way forward.

Instead of being able to gain directly-observable insight into users' practices, designers are given access to analytical data and mediated feedback concerning use by the same networked conditions that have so expanded the reach of their work (Blom et al., 2005; Crabtree et al., 2006; Kumar, Talton, Ahmad, & Klemmer, 2012; Tamminen, Oulasvirta, Toiskallio, & Kankainen, 2004; Zhang, 2005). While such data can be a boon for tracking and gaining detailed insight into use, it can also become unmanageable, with designers losing individual users in the wealth of data.

These networked affordances allow designers an avenue to understand users, albeit in a fashion distinct from traditional laboratory or field-based studies. Under these conditions, designers come to know their users through a dialogue that is mediated by the applications and the user feedback and data that is collected by designers as the applications are being used (Marcinkowski, 2013). As will be seen, the challenge comes in how designers are to utilize this data and user feedback in their work, particularly given the social and cultural influences that come to bear on use. That is, as use is broadened away from previous mechanistic terms (as can be seen in something like GOMS (John & Kieras, 1996)), there are questions as to how such data can be utilized and interpreted for the kinds of meaning-construction that have come to typify modern design (Ylirisku, Halttunen, Nuojua, & Juustila, 2009). All this is made more complex by the volume of user data that is possible today. Such use of large scale sets of user data will remain a key theme throughout this work.

**Social Influence and Technological Change**

In seeking to situate the question of design and the mediated relationships between designers and users, this research expands beyond the borders traditionally found when examining questions of design, and begins to address socio-technical questions concerning
technological change and human activity. While the following chapters will emphasize the question of technological change at a more fundamental level, there are nevertheless several currents of broader socio-technical research that are worth addressing.

As noted briefly above, central to many current approaches to HCI and design research is the emphasis on the importance that social and cultural factors have on the use and design of applications and artifacts. Most often, the social frameworks utilized either apply to the conditions of use (as with Activity Theory (Kaptelinin & Nardi, 1997) or embodied interactions (Dourish, 2004b)) or to prescriptive approaches for allowing the incorporation of "social" or "cultural" concerns (such as participatory design (Schuler & Namioka, 1993) or cultural probes (Gaver, Boucher, Pennington, & Walker, 2004)). In each, these social concerns are often localized only to the particular context of design or use (which is not to say that work connecting these localizations to wider views has not been conducted [e.g. (Bell & Dourish, 2006; Ehn, 1988)]).

While taking much from HCI research in terms of the understanding of the conditions of use, design, and the artifacts themselves, what is presented here extends beyond the reach of much HCI theory, and, in its aim to diagnose pathways and processes of socio-technical design, encounters a need for more robust theoretical account of technological change. In particular, given the encounter between designers and users that is central to this work, there is a need to consider the ways in which this encounter shapes the resulting systems and how, as this encounter is mediated through massive sets of user data, the processes of data analysis come to play a role. In their appeal toward the larger forces of society which may bear on the design of an application, standard social-shaping approaches (Williams, 1996) provide a good base outline for thinking about the engagement that occurs between users and designer. Put simply, they give a well-established theoretical account of the ways in which the forms of various technological artifacts and systems are influenced by processes of use and existing
social norms, in some cases to an extent that outweighs what may appear to be the direct influence of the work of design (Bijker, 1997). While providing a broad starting point, such social shaping approaches, in their focus on the macro conditions of social or economic forces, are unable to account for any analysis of the individual interpretive qualities of a designer or user such as are the object of this research. What is necessary is an approach to social systems that is able to account for both enabling and constraining facets of small scale social interactions. That is, to be able to understand the particulars of the processes of data analysis.

While by no means the theoretical focus of this research, in developing a novel theoretical approach out of the phenomenological roots of much work in design, the present research relies on some general themes developed out of Actor-Network Theory (ANT) (Latour, 1996; Law & Hassard, 1999; Tatnall & Gilding, 1999). That is, this work starts from an initial point in which technological change and influence, instead of positing the influence of “social forces,” lays out a picture of the aggregate development of what would be considered “the social” (Latour, 2005). In the model of symmetry of influence that spreads agency across an expansive network of human actors and non-human actants, ANT provides a first starting place for a broad-based analysis of socio-technical development. In its holistic approach to the conditions of socio-technical relations, ANT resonates with emergent and engaged perspective found in the kinds of phenomenological approaches that will be developed in a more robust fashion throughout what follows. As has already been shown (Ciborra & Hanseth, 1998; Harman, 2009), ANT provides entry into and substantiation of some of phenomenology's less concretized concerns. In particular, in its leveling of the agentive relation between human and non-human, Bruno Latour, despite his critiques of Derrida's concern with textuality (Hekman, 2009; Latour, 1988), finds a notably common position with Derrida's actual, more fundamental positions, particularly as Derrida is likewise
unwilling to firmly distinguish between human and non-human at a basic level (Roberts, 2005). Regardless whatever antagonisms and affinities may be present, ANT provides an easily accessible and desirable account of the symmetry of influence across individuals and their material conditions in a way which resonates with the emphasis on engagement found in largely phenomenological contemporary theories of use and offers a model of social development not reliant on an abstracted sense of the social. While I take on, theoretically, a model of the way in which social relations are gathered together in a manner described by Latour and ANT, I do not propose to take on ANT’s methodological or even terminological character. For what is to come, while not developed in its terms, ANT provides an excellent starting place for considering a generalized and accumulated picture of social effect.

As mentioned, what is central to taking up ANT’s conception of technological change is the role that non-human actors play in directing this movement (Latour, 1996). While much of the work here is to focus on the human processes of conceptual interpretation that are involved in design, non-human technologies and the material conditions of the artifacts themselves serve as a background against which such interpretations take place, serving as, to take Phil Agre’s phrase (1997), “generative metaphors” which guide the ways in which human interpretations play out. The values and meanings embedded in existent technologies that provide inspiration and support for design work can be seen to function as modes of tradition and prejudice when examined in terms of a hermeneutic understanding of interpretation.

This conception of the influence of non-human actors highlights a key motivation for this work: that the instantiation of material technological designs, as much as they may be targeted toward immediate immaterial social concerns, exist in a wider historical continuum, and continue to exert influence after the moment for which they are conceived—this largely following Langdon Winner’s consideration of the political implications of technological
artifacts (1980). While there is an obvious appeal here to a balanced approach in considering the agentic role of people and technology, the inter-dependence of the two cannot be overstated, with Agre’s generative metaphors being pushed toward a broader organizational stance. This presses for the necessity of understanding the processes which author such artifacts. As technologies come to be (as described in previous sections) more emergent social aggregations than material artifacts, these kinds of political implications come to rest in social encounters as well. For designers, it is the socio-materiality present in user data that provides relation to these emergent systems. In tracing out the influence that processes of interpretation can have on the work of design, the data which bridges the relationships between designers and users will be considered in this kind agentive light.

Most fundamentally, however, this work finds its socio-theoretical base as held within the phenomenological lineage developed from the philosophical work of Martin Heidegger. As already developed in part and as will be developed in more detail in coming chapters, this research into the understanding of technological design in the present moment of globally-connected information technology and the large scale data that this makes possible relies on an ultimately post-humanist reading of Heidegger and includes his considerations of social being (2010), technology (1977), and the work of art (1993). Heidegger's work is not taken at face value, but is, in various ways, approached through the critiques and expansions of those who followed in his wake. Speaking in roughly chronological order, this work turns to the philosophical work of Hans-Georg Gadamer in order to better understand and support renderings of the work of interpretation; the deconstructive philosophy of Jacques Derrida in order to understand ethics, the event, and the development of networks of meanings; and the work of Gianni Vattimo in order to understand the nihilistic implications of interpretation and the impact that current technologies have on our understanding of metaphysics. It is worth noting that Gadamer was a direct student of Hiedegger's, with Vattimo in turn a student of
Gadamer's. Derrida has been presented on the same level as Gadamer as following
Heidegger's thinking (Michelfelder & Palmer, 1989), with Vattimo (1993) receiving as much
from Derrida in some regards as he does from Gadamer. Like other theoretical support
provided by a range of work from the philosophy of science that will be sketched out in
coming chapters, the phenomenological lineage developed from Heidegger demonstrates the
sociological turn present in 20th century philosophy (Vattimo, 2004). That is, we come to
philosophical understandings through the analysis of the contemporary situation. In this, it
provides support for understanding the intertwined questions of technological use and design
as they exist across a complex system of socio-technical relations.

**Looking Toward Online Education Design**

The picture of socio-technical design that is developed here is given immediate and
topical grounding in the work of the design of online education, specifically within the
developing paradigm of massive open online courses (MOOCs). MOOCs provide a
particularly excellent case for supporting this kind of theoretical development as they present
a novel situation for design and use that relies on large sets of user data. More than just
technological assemblages, MOOCs (and online education in general) present large systems
of socio-technical engagement that have deep-set traditions and a wide reach into broader
social activities. In this, they offer the opportunity to look at the interaction of design, data,
and broadly set cultural values and traditions. This is especially the case given the still-
developing paradigm around MOOCs.

Considered in blunt terms, there are two main approaches to the organization of
MOOCs: cMOOCs and xMOOCs (Clow, 2013). cMOOCs, largely considered to have
initiated the concept of massively-scaled education, sought to bring together large numbers of
users who would be able to combine their individual knowledges in a connectivist learning
practice (Siemens, 2005), drawing together various fields and developing new insights. From
the standpoint of an educational philosophy, this kind of broad based and peer to peer strategy stands in contrast to the type of MOOCs that followed and that which gained wider appeal, xMOOCs. In xMOOCs, as first widely popularized through Stanford’s course on artificial intelligence introduced by Sebastian Thrun and Peter Norvig (F. G. Martin, 2012), students engage with a course largely in the manner of a traditional face to face, top down course: they watched a lecture, read texts, took quizzes, and so on. Where cMOOCs placed interaction between students themselves at the heart of the function of a course, xMOOCs maintain a more traditional approach to student interaction, seeing it as a benefit that follows along after the main pedagogical guidance of the instructor. That is, the values of traditional modes of education seem to be carried over more directly in xMOOCs. However, in their own unique history (as their origins lay in cMOOCs) and technological affordances, xMOOCs nevertheless present an open field of conceptual and paradigmatic development. In this, MOOCs provide a unique and dynamic case for understanding socio-technical design.

Unlike other situations of use with immediate and easily-demarcated concerns (such as air-traffic controlling (Bentley et al., 1992), for instance), education (and online education) represents a set of practices that are explicitly concerned with questions of conceptual work and cultural intelligibility (Mitchell, 1999; Young, 2008). Importantly, online education provides an excellent case of the socially-embedded uses of technology, with education extending to and being integrated with a wide range of social interactions, structures, and values. In this, online education is concerned specifically with the types of issues—culture, values, deep engagement—with which technology design is currently involved. That is, in online education, the meaningful and conceptual nature of use is made explicit.

In this focus on the conceptual development and meaningful effect of use, designing for education finds resonance with the kind of interpretive work of design described by Sengers and Gaver (2005) and, in so far as it is of a (broadly understood) textual nature, in
research which understands design as a semiotic practice (de Souza & Leitão, 2009).

Practices of design and use come to mirror those found in the instructor-student relationship. In both cases, there is a concern for the interpretive and semiotic activities of designers (instructors) and users (students), and the explicit forms of textual (again established in a broad sense) interpretation. As such, there is a concern for the dialogic impact that design work has, even on the designer/instructor (Bennett & Lockyer, 2004; Bovill, Cook-Sather, & Felten, 2011; Koehler & Mishra, 2005).

Practically speaking, online education, as an object of study, provides a unique opportunity for understanding the role that inter-cultural interactions may play in process of design. With their explicitly global reach, online courses draw on a diverse set of students from a variety of backgrounds. For educators and instructional designers working to design a course this can pose a difficulty in attempting to shape a class so as to meet the needs of users who are not only remote in terms of their location, but also remote in their cultural and interpretive frameworks. Student interactions with designers and educators are almost entirely conducted through mediated means, with designers and educators having to rely on student data and feedback received as part of a course in order to make changes to the course. User (student) data comes to play a central role in the work of design, and provides a rich resource for understanding the development of such a large socio-technical system. As such, for research which looks to situate the process of design as it is mediated by large sets of user data within a robust and value-laden setting, the design of online education proves to be an excellent opportunity to develop socio-technical theories of design and technological change.

**Opportunities and Challenges for Design in Online Education**

Currently, there is a tremendous growth in both the interest in online education (Allen & Seaman, 2011, 2013) and in research surrounding the uses and design of networked
technologies for education (Juwah, 2006; Koehler & Mishra, 2005; Laurillard, 2012; Petre & Shaw, 2012), particularly in post-secondary, college level education.

Even though the educational aspects of online education are not explicitly addressed here, the tradition of dialogue in education (and particularly recent constructivist trends in education research (Fox, 2006; Karagiorgi & Symeou, 2005; Schwartz, Lindgren, & Lewis, 2009)), serves to highlight the mode of shared shaping of socio-technical forms that is sought to be understood in the process of design and use. While the aim of this research is to examine the occurrence of design in general, in many ways, online education design bears a strong resemblance to the HCI design, highlighting the interactionist, iterative, and shared nature of design work (Bovill et al., 2011; Koehler & Mishra, 2005; Laurillard, 2012).

The case of online education is made more complex, however, by the fact of its entanglements outside of a case of “pure” design. Education design is not a simple case of one designer designing for a pre-established audience with well-defined needs and requirements. With it comes a host of pre-given and external conditions that influence the work of design. From institutional pressures, to cultural standards for education, to technological constraints and innovations, the work of designers takes place within a field of social and cultural action. Designers and educators work together in order to design materials and systems for students from around the globe. In this, designers and instructors work to build an understanding of the designed course with students, navigating the cultural and social meanings of education alongside a population of students who may not share the same sets of tacit values. These factors contribute to a specific picture of constrained design work, one in which the process of design is limited by globally-scaled and distributed conditions external to design, whether those conditions may be readily known or not. This very difficulty, however, is in many ways the focus of this research: the complex interaction of large scale data within a wider setting of the instantiation of designed technologies.
Looking Ahead

Following this general introduction, chapter 2 will provide a detailed review of the literature which provides the general background and framing to this work. From that starting point, chapters 3, 4, and 5 will be dedicated the theoretical development of the present space of interaction design, particularly as it relates to questions of values, online education, and large scale data. Chapter 3 will focus on the interplay between “immaterial” concerns such as values and the “material” concerns of technology, while also considering the relationship and common themes that develops between interaction design and online education. In doing this, a Derridean-inflected conception of the work of design as an eventful and ethical process of phronetic judgment (as derived from an Aristotelean sense of practical wisdom) is developed. Chapter 4 explores the epistemic issues that surround the question of big data in the work of design. Relying in large part on the picture of a combined epistemology and ontology as developed by Karen Barad, this chapter presents a radical reconsideration of the possibilities of empirical research, and puts forward a consideration of the new conceptual space offered to interaction design by big data. Chapter 5 follows on this consideration of big data to look at how such large sets of data can be utilized in the work of online education, particularly in their ability to address individual students. Relying on Heidegger's figure of Das Man, this chapter provides a mapping of the conceptual space of the actual use of big data by designers. Chapter 6 serves as the empirical fulcrum of this research and presents the analysis of student forum data produced by three MOOCs. In this, an abstract typology of critical incidents that occur in MOOCs is presented. This typology illustrates the kinds of events present in the data that serve to drive the continual process of design in MOOCs. These two chapters (5 and 6) directly address the question of the specific setting of online education. As the final chapter, chapter 7 explores the total situation of the use of big data in design and follows along a reading of Heidegger's (1977) essay “The Question Concerning Technology”
in light of advances in information technology and large scale data collection. The most explicitly sociological and critical of all the chapters, this chapter lays out the implications that big data has for interaction design in the light of Heidegger's path-making essay. Finally, a short conclusion follows which synthesizes some of the main themes that are developed.
Chapter 2

Background: Understanding Users Through Data; Phenomenology in HCI

In order to set the stage for the considerations of socio-technical design presented in the following chapters, this chapter will review the trajectory of the development of human computer interaction design and its evolving concerns as they point to more immaterial and emergent concerns, such as values and culture in design. Looking specifically at how HCI designers have been both understood and recommended to consider their users, epistemological issues will be raised, and existent considerations of exchange between designers and users as part of design will be detailed. This review then turns to a deeper consideration of previous uses of phenomenology and hermeneutics in the study of technological design, as such approaches provide the philosophical basis for the theoretical development that is to be presented. The aim is to sketch out an account of the space in which designers and users interact, and to detail the main concerns and terms of that interaction.

This chapter draws out a two part movement of the development of understanding interaction design. First, starting from a consideration of an information processing model of use, the question of interaction design moves toward a situational consideration of use which focuses on both the immanent and the external influences on use. Second, this thinking of the specific relations of the immediate situation is given social, cultural, and value-laden form. In each of these, static and positivist epistemologies are overturned in favor of increasingly progressive and interpretive approaches. These movements open up questions concerning phenomenology, and to the ways in which designers and users enter into dialogue concerning these social understandings that shape design and use.
Design and the Developing Understanding of Use

The question of the nature of design in human computer interaction (HCI) is not a new one, with HCI finding its root in the question of how to design systems that are easy to learn and easy to use (Carroll, 2010; Gould & Lewis, 1985). Much of the initial formulation of the question of design in HCI (Carroll, 1997; Ehn, 1988) starts with the characterization of computer design put forward by Herbert Simon (1969). In this reading, Simon is seen to define a formal science of design which, by disclosing the possible worlds available at any particular moment, would allow for an satisficing coupling between computers and their human operators. From this basis, the question of human-machine integration utilized approaches developed from cognitive science, most notably illustrated by the model human processor and other approaches which sought to specifically define the cognitive requirements for optimal use (Card, Moran, & Newell, 1983; Newell & Card, 1985). That is, the human user was considered to be part of an information processing circuit within which the human components would be able to be methodologically diagnosed in a rational fashion, and the system designed in accordance with any principles that could be defined.

This system-centered approach proved to be useful when considering working programmers and specialized, non-discretionary, and mission critical work (Grudin, 2005), but became less effective as non-specialists came to the table and the range of tasks associated with computing expanded (Carroll, 1997, 2010). As interacting with computers moved away from being just the domain of experts and the tasks taken up by computing became less specialized attention began to be focused on how to design for users situated in a wider environment (Suchman, 2006). These users were seen as interacting with others and their dynamic surroundings, with the specific goals implicit in earlier models of work (e.g. (Card et al., 1983)) replaced by wider and more collaborative work processes (Button, 1990). This led to the utilization of numerous new approaches to conceiving of the contextual user for
whom interactions were to be designed: activity theory saw them as immersed in social
relations in pursuit of an object (Kaptelinin & Nardi, 1997), situated cognition which merged
environment and thought (Suchman, 2006), or distributed notions of cognition which saw
users thinking together (Hollan, Hutchins, & Kirsh, 2000). These approaches pulled the
conception of the user further from the system and highlighted the larger social and
environmental conditions of use (Grudin, 1990; Nardi, 1996).

These changes in how use was understood affected how the question of the user was
to be approached and what design was able to encompass. Instead of focusing only on the
interior, rational processes of individual thought, the user became intertwined with the wider
world and came to be understood as a more dynamic figure. In general, use was no longer
able to be approached in a programmatic fashion: it was contextual, mutable, and relied on
users who were more invested in the world around them than were previous specialist users.
The context of use became created by users through their work. As such, new methods were
applied to the question of the user in order to collect information that could help guide the
work of design.

**Empirical or Intuitive: Two Approaches to the Situation in Design**

In facing this challenge of how to approach a diversity of possible conditions of use
and the implications of a complex user, many approaches—ranging from participatory design
(Björgvinsson, Ehn, & Hillgren, 2010; Ehn, 1988; Schuler & Namioka, 1993), to
ethnography (Button & Dourish, 1996; Dourish & Button, 1998; Suchman, 2006), to
scenario-based design (Carroll & Rosson, 1992; Carroll, 2000), to end-user programming
(Ko et al., 2011; Nardi, 1993)—developed. In particular, by taking a closer look at both
ethnographically-inspired approaches and scenario-based design, it is possible to highlight
two distinct aspects of these new methods which distinguished them from previous attempts
at a purely rational design: for interaction design, there came to be a respect first for the
importance of a wide empirical knowledge concerning the situation of use and second for a personal and intuitive reflection on the part of the designer. As will be detailed by contrasting ethnographic-based approaches with those focusing on scenarios of use, situations of both use and design come to play an important role in understanding design.

To start, put broadly, ethnographic approaches are utilized in order to provide designers with a rich description of human interactions with technology and to provide an account of technologies as being constituted as a series of human practices (Button, 2000; Dourish & Button, 1998; Suchman, 2006). By carefully observing and engaging with users, designers are able to gain insight into how users think about and understand their uses of technology so that technological solutions may better match the situations and practices of use. Such ethnographic methods rely on detailed observation and immersion in the culture of use being studied (Crabtree, Rodden, Tolmie, & Button, 2009) through which designers are able to produce designs which give the technologies an appropriate role in accordance with the culture at hand and the particular ways and practices of a given setting. As such, the results of ethnographic work are largely unique to the culture or situation of use studied (Dourish, 2006, 2007). In some varieties (Sengers, Boehner, David, & Kaye, 2005), an ethnographic method seeks to provide a mode of holistic reflection of the kind of holism that had come to be recognized as necessary in the work of computer and technology design. Ethnography allowed designers to motivate their work through a reflection on the complex empirically-observed conditions of use.

On the other hand, the utilization of scenarios in design (Carroll & Rosson, 1992; Carroll, 2000) provides an alternative approach to such empirically-founded understandings of use and design. By acknowledging the iterative and emergent interactions that transform activities as new technologies are introduced (Carroll, Kellogg, & Rosson, 1991), scenario-based design seeks to provide designers with a loose methodological approach by which they
can project the possibilities of such changes to the situations of work that the introduction of new technologies would bring. By creating hypothetical vignettes of use generated from designers’ own experiences and understandings of human behaviors (oftentimes augmented by interviews and data collection that helped inform their understanding of the situation of design), it is possible to account for and assume the possibilities that a new technology may open up and for designers to make some kind of generalizable claim about a particular aspect of a system (Wright & McCarthy, 2005). With a focus on the imaginative abilities of designers to be able to forecast potential opportunities and pitfalls in design, scenario-based methods attempt to consider the complexities of use scenarios in a cost effective manner. In this, scenario based design specifically highlighted the value that the individual intuitions of designers have in understanding the complexities of use.

These two approaches are by no means the only methodological approaches developed in order to address the questions developed with the advent of a contextually-situated user, nor are they limited to only the somewhat brief and caricatured versions presented here. Nor are the two approaches entirely distinct. However, what is illustrated through such a presentation is the spectrum of possible responses to understanding users. One (ethnography) is outwardly-looking, explicitly concerned with taking in data concerning foreign phenomena so as to address that singular instance of use. The other (scenario based design) is concerned with an inward-looking, creative and intuitive investigation into the claims that can be seen being made by a new design so as to produce generalizable claims about complex phenomena. Neither can be wholly isolated from the other: A designer working as an ethnographer, despite all their observations, still looks for opportunities in design, and a designer dreaming up scenarios may still collect data (even perform an ethnographic study) in order to inform their creative work. Both are interpretive, both utilize the designer/researcher as the instrument, both respect a complexity of use not seen in strict
information processing models of use, and both sought, very specifically, to improve and enliven the possibilities for understanding and designing computer technologies.

What contrasting the two approaches highlights are the dual centers for design work when it comes to understanding use. On the one hand, ethnography, in a very deliberate way, hands over much of the impetus for design to the existent situation, with the ethnographer reducing their own agentive role in the design process, focusing on the empirical minutia of the work. On the other hand, in scenario based design, the creative and imaginative powers of the designers themselves are the driving force in design, with designers' analytic ability to understand the possible complexities of use and to understand the claims that any technology may make on the conditions of use exerting their influence. Each escapes a strict and simplified empiricism in favor of an interpretive respect for complexity (ethnography sometimes too much so (Crabtree et al., 2009)), albeit in distinct ways: ethnography seek an assimilation of experience, with scenarios applying already-won experience to the problems of design.

Moving from the Situation of Work and on to Everything

Central to the developing understating of use that framed designers' approach to users was the rise of personal computing, and particularly the new understandings that came with the emergence of discretionary use (Grudin, 2005). With the rise of discretionary use, there was an expansion of the criteria of a system from being something that got a job done to something that brought satisfaction and even enjoyment (Carroll, 2010). With this, computing began to take on an air of ubiquity, both in its resemblance to the ideas of ubiquitous computing initially developed by Weiser (1991) and in its more demotically-understood ubiquitous presence in everyday life: it became possible to integrate computing into a wider range of activities. Driven on by the rise of networked connectivity largely made possible by the Internet, understandings of design have been marked by an emphasis on deep
cultural and social engagements that computing both affects and is affected by (Grudin, 2005). Just as there had been a movement of understanding use that developed outward from understanding the system to the user to the setting of work and then to the social group (Grudin, 1990), there is a continuing movement away from the material particulars of computing, toward the emergent materials of culture and social interaction (Kamppuri et al., 2006).

As much as it took some effort to recognize this expanding sphere of use, this was not a radical break with previous criteria for what was important in design. Already in the 1980s, as workplaces began to rely more heavily on computers and workers utilized them for collaborative work, there were considerations of how social and institutional dynamics played a role in the success or failure of a design (Carroll, 2010). What comes to be unique and defining in the present moment is this ubiquitous sense of computing, that computers, instead of being something that is “over there” and is cordoned off and reserved for some specialized tasks, come to be understood instead as something deeply personal and intimate (Bell et al., 2003). Computing comes to align with immaterial, social concerns that are less focused on immediate, physical objects, and more on the types of aggregative movements that define social conditions (Latour, 2005). The materials of computing come to stand in symmetrical relation (in the Latourian sense) with the human meanings by which social forces are recognized in the course of conscious social aggregation.

**Culture and Identity**

In charting out the rising immaterial implications for the work of design, it is helpful to start by looking at some of the implications and pathways of influence that modern interactive computing presents. As has been identified in several areas, in its reach, computing comes to be able to play a role in defining (Lamb & Davidson, 2005; Turkle, 1994) and shaping even the personal identity of users (Bers, Gonzalez-Heydrich, & DeMaso,
2001; Bers, 2001; Mamykina, Miller, Mynatt, & Greenblatt, 2010) in a way that is carried with users both in their future technological interactions (Wright & McCarthy, 2005) and beyond their explicit interactions with technologies. Affective computing (Boehner, Chen, & Liu, 2003; Boehner, Depaula, Dourish, & Sengers, 2007; Picard, 2000) and reflective approaches (Sengers et al., 2005) engage users at a thoughtful and emotional level, rather than in a mode of explicit and practical use. Traditional understandings of ubiquitous and calm computing (Dourish, 2004b; Weiser, 1991) expand the reach of conceptions of use further, pressing for a sort of unconscious, but still active, form of use. Even passive and secondary modes of use have come to be recognized as important once this demotic ubiquity is recognized (Ferneley & Light, 2006, 2008), especially as computing comes to be woven into public and social engagements at large (Bell & Dourish, 2006). All these concerns are such that they point away from the immediate physical materiality of the designed artifact and toward an immaterial consideration that focuses on how computing comes to be conceptually understood and intertwined with complex social behaviors (Norman, 2010). In many ways, what all this points to is a dissolution of any moments of particular use and the rise of a culture of use in which the question of use itself becomes embedded within any number of social activities.

With this close connection between social activities at large and computing, culture—as understood as a background of tacit and localized knowledge and behaviors—is brought specifically into contact with computing (Heimgärtner, 2013; Sengers et al., 2004). “Culture” comes to play both a positive role as something which designers should attempt to investigate and adapt in their designs (Gaver et al., 2004; Gaver, Dunne, & Pacenti, 1999), but also takes a negative light when issues of cultural imperialism and western hegemony are considered (Dourish & Mainwaring, 2012; Irani & Dourish, 2009; Irani, Vertesi, Dourish, Philip, & Grinter, 2010; Philip, Irani, & Dourish, 2010). When the cultural assumptions built into
applications align with the culture of users, this can lead to applications that are easier to use and thus more widely adopted (Walsham, 2002). At the same time, however, the cultural assumptions present in an application can also limit the possibilities that users see in the application. Taken either positively or negatively, cultural values and ways of approaching the world are seen as being embedded in technologies (Winner, 1980) and the generative metaphors that they support (Agre, 1997).

These concerns, both positive and negative, point to developing understandings of use that combine local cultural attitudes (Zakaria, Stanton, & Sarkar-Barney, 2003) with a consideration of how individuals in those cultures approach those shared cultural understandings of technologies (Glöss, 2012) and the tensions that may be felt within a seemingly homogeneous culture. Reflective approaches to computing (Sengers et al., 2004, 2005) make an attempt to produce designs which encourage both designers and users alike to reflect on the tacit conditions of that inform technology design, so that responsibility for how an application comes to be known can be given to users and not the technology itself. Such approaches point to the ambiguity that is necessarily present in design, finding that cultural concerns are handled effectively when such ambiguity is highlighted and room is left for interpretation on the part of the user (Gaver, Beaver, & Benford, 2003; Sengers & Gaver, 2006). In this way, the responsibility for computing comes to be spread across designers, users, non-users, as well as the applications themselves (Wright & McCarthy, 2005). Just as there has been a reassessment of the discursive distinction between humans and the machines they are seen to interact with (Suchman, 2006), as computing has become embedded in social systems, so too has the similar discursive distinction between design and use been called into question (Neustaedter & Sengers, 2012). In this, there is a resistance to the purity of any pre-given categories, whether they be human or machine, design or use—a theme that will be developed throughout the chapters which follow. As will be seen in the discussion of user-
designer dialogue below, the social modes which are driven by these intangible concerns such as culture and identity are what come to be the object of design in pervasive environments of computing.

Values

At a more fundamental level, these issues of culture and identity come to be grounded in questions of the kinds of values that come to be instantiated and enacted in the design and use of interactive technologies. The motivation for this viewpoint is given broad definition under the rubric of value sensitive design (VSD) (Friedman, Kahn, & Borning, 2006, 2008). As a specific methodological approach to design, VSD was established based on a set of tripartite investigations (conceptual, empirical, and technical) which sought to uncover, distill, and reflect on those innate values that may be designed into artifacts. Such an approach was founded as an attempts to regulate the development of artifacts that may otherwise be left to enact their own political wills (Winner, 1980) in uncontrolled ways. In this, VSD highlighted the question of how designers respond to the values of users, how they respond to values already present within a society or design framework, and what kinds of values they impute into the design itself.

Like cultural concerns of design, considerations of the values in design address the often low-level assumptions that get packaged into designers' work, often unknowingly. This characterization of “value” is distinct from the types of values that can be seen being applied to the production and sale of commodities, as that extra bit that may be sought from a design (Cockton, 2004), though, to a certain extent, there is room for a common understanding between the two uses. In the case of the debate over what manner of cultural values should be embedded in the design (or redesign) of Internet architectures (Brown, Clark, & Trossen, 2010), there is both an overt discussion of cultural values (those which normally remain tacit and unconscious) and the hope that those values will thus propagate so as to add extra value
(in the commodity sense) to the system at large: by asserting cultural values of democracy, liberty, etc. designers would hope to reap the value of those being spread abroad.

Such considerations of the reproductive nature of any values that may imputed into designs finds resonance with early work on participatory design (Bjerknes, Ehn, & Kyng, 1987) and the linking of the inclusion of users in the work of design to ethical and humane labor conditions (Ehn, 1988). In this early Scandinavian work, there is a sense that if those who are going to be using a system in their labor have a hand in its design, they would be able to reap the benefits of the values designed into it. That is, the values of respecting laborers, of equality etc. that are designed into a system would reproduce themselves in the use of the systems. It is possible for designers to produce systems which explicitly seek to instill certain values in their users, whether intentionally or not (Knobel & Bowker, 2011).

This approach to values, however, is not without difficulty. If such values are to be considered by designers in their work, there are questions regarding how, and by what criteria, values are to be judged and even understood (Dantec, Poole, & Wyche, 2009). Even the founding principles and conditions of the establishment discourses on values are themselves suspect to the value-laden framing that directs discussions of values (Woolgar & Cooper, 1999). So, on the one hand, there have been attempts at some codification of values and the development of explicit frameworks for how designers should approach the issue of values in design (Friedman & Kahn Jr, 2002; Friedman et al., 2006). However, on the other hand, given that values are tied to the cultures in which they are expressed (Friedman et al., 2008) and are evolving products of lived experiences (Dantec et al., 2009), how is it possible to codify values into universally-intelligible propositions (Borning & Muller, 2012)? The very question of values in design is something which is itself immersed in ancillary question of the determination of the values which it seeks to represent.
This question of how design is to understand values bears a resemblance to questions about the types of understanding that ethnographic and culturally-centered research faces (Boehner, Vertesi, Sengers, & Dourish, 2007; Dourish, 2006, 2007). In each, there is emphasis given to the lived and active nature of human engagement with technologies (Button & Dourish, 1996; Dantec et al., 2009). Even as attempts may be made to link technologies to values and culture in a quantitative fashion (based on the technology acceptance model and Geert Hofstede's cultural dimensions (Zakour, 2004), for example), there remains a question of how a productive activity such as design takes account of such generative and lived things as culture and values in their work. This question is especially problematic when something like “value” is considered in the dual way in which it may be a tacit and almost undefinable thing such as “freedom,” while simultaneously such a value is wanted to be produced as the outcome of a design, in the commodity sense of the term.

As is laid out in discussions of value sensitive design and the wider concerns of computing design (culture, identity, etc.) discussed above, it is not always just the explicit, material functionality of computing that has an effect on a technology’s reception and use (Poole, Le Dantec, Eagan, & Edwards, 2008). Technologies do not rely only on their functional or practical aspects for the success or failure, and instead rely on complex networks of social and personal judgments that may or may not be based specifically on the affordances that are central to the design of a technology (Bijker, 1997). This immaterialization of effect—that computing comes to rely on things such as culture and value that are not explicitly materially present in the artifact—pushes the question of design away from the consideration of only the physical, material artifacts of technology, and toward a conception in which design is seen as occurring in a wider network of socio-technical relations. Beyond the kinds of totem-like value-centered auras (in Walter Benjamin’s (1968) usage) that artifacts may have, or the political implications which they
might push forward (as in the case of Winner’s (1980) varied thinking of the relationship between values and artifacts), there comes to be a distinctly Foucauldian flavor to the conception of design that has been developed. The design of technology is not limited to the material artifacts of technology. Instead, it encompasses concerns for the practices and conceptual lives of users (Foucault, 1978; Matthewman, 2011). More than just a form of material intervention in the world as Simon (1969) might be read, it plays the role of constituting the disciplinary matrices of discursive development.

This presents unique epistemological challenges for designers who look to consider users as part of their design process: how are they to come to understand their users, and how should these immaterial conditions of design be reflected in the systems which they design?

**The Epistemic Shift**

With this movement from the specificity of work to a wider understanding of use, there is a necessary development in the epistemological consideration of design (Bødker, 2006; Harrison et al., 2011). Motivated by a need to be able to account for the situated nature of computing and the immaterial concerns of identity, culture, and values, any epistemology used in the support of design requires the ability to develop an understanding of design as contingent, immaterial, and changing. In short, this development is from a positivist to an interpretive epistemology in which any knowledge developed is understood only in a situated fashion.

This change in epistemology has two main sites: the understanding of the user and the self-conception of the activity of design. These two sites coalesce into a singular picture of the change of the epistemic nature in design in how they both relate to the entwined relationship between design and use.

As has already been discussed above, approaches to design have developed to no longer think of users as acting in a simple and pre-defined manner. Instead, in their
interactions with computers, there is a focus on the specific, complex, and changing conditions that engender practices use. Frequently, this dynamic understanding of the context of use evades any simplified codification, and pushes designers, each through their own investigations, to engage in any particular situation of design in a singular fashion (Dourish, 2006, 2007). Even in the case of non-ethnographic research, when attempting to look at the way in which culture plays out in the case of use, it is not possible to generate specific and point by point knowledge (Boehner, Vertesi, et al., 2007): not only are values living things (Dantec et al., 2009), but use has the ability to change the conditions in which an artifact is used (Carroll et al., 1991; Sengers & Gaver, 2005).

Because of this change in the way that designers conceive of the conditions of use, there is an analogous shift in the understanding of the practice of design itself. Moving from a fully rational basis, design comes to be understood as a craft-like activity (Carroll, 2010), not one based on deductive principles, but instead on a learned-practice and the employment of heuristic guidelines. As it engages in the dynamic development of cultural and social values, design takes on the character of a reflective practice (Sengers et al., 2005), one which reacts to and is developed by an engagement with both the aims and the objects of its work. No longer is there a singular solution that is proposed in response to a defined problem in design, but rather there is seen to be a co-evolution of both the problem and solutions space of design (Cross, 1997; Dorst & Cross, 2001). Empirical work done under these conditions comes to be understood not as only providing details around which a design is shaped, but as also offering deeper understandings of the productive trajectory of a design (Boehner, Vertesi, et al., 2007).

In this light, the work of design comes to resemble the work of translation (Muller, 2004), where the needs of users are translated from the context of the users’ expression of those needs, to the designed artifact itself. With this, there is a certain impossibility of
traditional rationality that occurs, with the act of translation prohibiting a one to one match between the initial conditions and those developed through an act of translation (Gadamer, 2004; Polanyi, 1983). In this active sense, design cannot be considered as simply meeting specific needs, but is instead a transformative activity, one that is constituted both by the initial situation faced by a designer, and also by the way in which a designer faces any empirical knowledge regarding users and use. The resonance here with both hermeneutics and the kind of symmetry put forward by Actor-network Theory should not be overlooked.

These issues point to an interpretive, phenomenological epistemology, one which continues the conceptual de-materialization of the object of HCI design that began with considerations of situational use and continued with an emphasis on values and culture. The material artifact no longer wholly determines the use of the artifact. Instead, the uses and meanings found in an artifact are determined by the surrounding aggregate social relations (as described by Latour (2005)). Epistemologically, for understanding use and design, it is these forms of social aggregation (which include human actors together with technological artifacts within a common world) that come to be the object of investigation and manipulation in design.

Before looking at these epistemological issues in more depth by reviewing the uses of phenomenology in HCI design work, and how existent applications of phenomenology consider the development of the understanding of design and use as taking place within such a common world, existent hermeneutic and dialogic approaches to design will be discussed with the aim of highlighting the meaning-making and practical considerations of such design work. In large part, this sense of dialogue develops out of the idea that designers, in understanding users, should find some empirical basis stemming from the perspective of users on which to base their design decisions. Developing from this, so called “big data” will
be discussed, as such large scale mechanism of data collection serve to facilitate this dialogue between designers and users.

**Dialogue and Design**

Fundamental to the work of user centered design has been a concern on the part of designers for the needs and opinions of their users. Such needs and opinions are thus to be reflected in the design itself, and in this, a back and forth dialogic movement is formed between designers and users (Carroll et al., 1991; Grudin, 1990), with users expressing needs which are answered in the designed artifact. Any setting in which designers seek to gain insight into the needs and requirements of users—explicitly user-centered or not—affects some form of dialogue. Whether through simple questions, a deep ethnography, participant observation, cognitive walk-throughs, or a caricature of user-centered design in which designers pander to users' most ill conceived and minute suggestions (Norman, 2005), there is some basic dialogic movement involved in design. This dialogue comes to be particularly necessary when considering questions of pervasive and social use, in which the technologies that are designed come to define users' understandings and meanings in the world (McCarthy, Wright, & Cooke, 2004). This is all the more central when questions of social relations and culture (and other human aspects of technologies) are seen as contributing important insights to the process of design (Sengers et al., 2004).

These modes of dialogue in design are not, it should be emphasized, unique to current conceptions of design that are explicitly concerned with immaterial aspects such as values, culture, or social relations. Standard conceptions of user-centered design have long seen the process of design as an iterative negotiation with users. In the case of the task-artifact cycle (Carroll et al., 1991; Carroll & Rosson, 1992), the conditions of use are seen to be affected and changed by the introduction of new modes of technological interaction. In turn, once these new conditions are observed by designers, such changes necessitate a reevaluation of
the original design. Through this iterative and dialogic engagement, designers and users, in a way, work together to reshape their understanding of the artifact and its corresponding task. Similarly, semiotic design approaches (de Souza & Leitão, 2009; de Souza, 2001) also highlight a mode of dialogic meaning-making in interaction design. In these approaches, design work is guided by understanding the way in which a designer and user may communicate through the modal textual dialogues present in a system. The designer speaks to the user in a form embodied by the system (modal dialogue, window text, etc.). Semiotic design strategies show how user-designer dialogue is not just concerned with the design of applications, but continues through the process of use as well. This kind of approach is further highlighted in the appreciation of dialogic conceptions of meaning derived from literary considerations of user experience (Wright & McCarthy, 2005). Together, the task-artifact cycle and semiotic design paint an end-to-end picture of the work of dialogue in traditional HCI that is helpful in laying the ground for how dialogue functions in newer forms of interaction and design. In all of these, users and designers are seen as both bringing their previous experiences to bear on the technical artifact in question (Wright & McCarthy, 2005).

Beyond a basic user-centered perspective, the move toward a situated, interactivity, and largely phenomenological epistemic position further highlights the importance of dialogue in design. Knowledge about design is not just something that that is to be discovered in a positivist sense, but it is something that must be constructed and engaged with in an iterative fashion in order to be understood (Carroll, 2010; Dourish, 2006). It is largely this dialogic approach to epistemology, one that can accommodate the kinds of meanings and conceptual apparatuses present in design today, that will drive the consideration of phenomenology later in this chapter.
In approaching the confluence of the epistemic development in HCI and the rise of pervasive and immaterial social uses of technology, it is useful to consider the dialogic understanding of design developed by Donald Schön (1996; 1992). More than just considering dialogue to be part of design, Schön found dialogue to be central to the activity of design itself. In this, his thinking of dialogue is distinct from the kinds of dialogue between designers and users as described above. Investigating the work of designers in a particularly hermeneutic light, Schön developed a conception of design as a conversation with the materials used in design. In this, he saw design as progressing through a reflective dialogue between what was being designed and the design practitioner. Starting from an analysis of architectural and urban design, Schön observed that with each manipulation of the materials of that which was being designed, the designer was presented with a new arrangement of materials on which they could reflect, a conception which finds support in Heidegger's radical positioning of the hermeneutic nature of experience (2010). This process of reflection opens up possibilities not previously present and leads to the kind of “newness” that characterizes design work (Bødker, 1998). Central to this is the notion that the isolated designer alone cannot engage in practices of design. There is a necessary engagement with the materials being designed, and both the designer and the materials have an agentive role in the process of design (Cardoso, 2009).

This fundamental role of dialogue in the activity of design collides with the kinds of dialogue seen in user-centered design practices, particularly as the uses of applications become more social and pervasive. Schön's conception of design as a dialogue with materials subsumes the kind of dialogue seen in user-centered design, with the immaterial and increasingly socially-oriented conditions of technological artifacts coming to be the reflective focus of the work of design. In this, social relations, values, culture, etc. become the materials of design with which designers reflect, with designers gaining access to these
“immaterial materials” through traditionally-oriented dialogic engagements with users. The social material of the designer-user dialogue becomes the material with which designers dialogically engage.

Following the picture already developed in the above sections of the concerns of HCI design evolving to include culture, values, and other situational aspects, design in HCI is faced with the unique situation of having their materials of design increasingly become *immaterial*. The particular material construction of an application or system (the software code or hardware) is given secondary emphasis in favor of what the application or system can immaterially achieve through the reorganization of social and value-laden relations. That is, design in HCI comes to be more about what a particular design may *mean* than what it *is*. This is a proposition put forward both by research into semiotic design (de Souza & Leitão, 2009; de Souza, 2001) and inquiry into users' experiences with applications (McCarthy et al., 2004; Wright & McCarthy, 2005). Much like the movement to understand aspects of ubiquitous computing (Agre, 2001; Chalmers, 2004), the context and situation of use is central to the way in which any application both functions and is understood. On both the side of the application (Bardram & Christensen, 2007; Dourish, 2004a) and of the user (Sengers & Gaver, 2005), there is an understanding that this kind of meaning is something that must be explicitly interpreted and not left to only an objective account of the material components of an application. That is, the meaningful confluence of system interactions centers around the particular setting of design and use which provides a background for the interpretive exchange that occurs between designers and users (de Souza & Leitão, 2009; de Souza, 2001; Wright & McCarthy, 2005). The application or system being designed plays a dual role, both as object of discussion, and as meaningful mediator (Dearden, 2006; Marcinkowski, 2013).
The case of values and other explicitly immaterial, human concerns in design highlights the way in which designers engage in a dialogue with users about the social and cultural uses of the artifacts they design (McCarthy et al., 2004; Wright & McCarthy, 2005). Where Schön (1996; 1992) saw designers engaging in a hermeneutic reflection with the materials of design which opened up the possibilities in the given materials and re-oriented the appraisal of the problem and solution spaces (Cross, 1997; Dorst & Cross, 2001), HCI design is faced with an analogous mode of reflection. What HCI designers face today is a dialogue with the *immaterial* of culture and values. As user-centered design and understandings concerning the situated nature of use have shown, successful applications are not made simply through the use of the most advanced technologies or best coding, but through proper integration with and understanding of the immaterial contexts and purposes of use. In this immateriality, designers must go to their users who are also engaged with such immaterial structures as society and culture, and engage them in an exchange about what should and what can go on through design and use (Dubberly & Pangaro, 2007; Dubberly, 2008). Instead of designers finding meaning in the physical materials of their work (lines of code, hardware sensors), the meaning and “material” of design is centered on the very “immaterial” conditions of society and culture.

In this, design can be characterized as a mode of meaning-creation between the designer of an application and its users (McCarthy et al., 2004; Wright & McCarthy, 2005). On the one hand, designers work to understand their users (e.g. (Bentley et al., 1992; Gaver et al., 1999)) and at the same time users need to understand the designs with which they interact (Carroll & Rosson, 1992; Poole et al., 2008; Rogers, 2006). This conception of the shared work of design and use disrupts the traditional goal (e.g. (Dourish, 2004b; Weiser, 1991)) of modes of seamless and calm computing in which users seem to simply fall unthinkingly into use. While having such a goal may be generative in some cases, there
remains a fundamental question (Chalmers & Galani, 2004) of how an artifact, if it is to achieve anything beyond the already existent conditions, is able to become so routine that it goes unnoticed (Turner, 2013). At some point the user must step up to make sense of the application, just as the designer works to make it intelligible.

**Purposes and Methods of Dialogue in Design**

Forms of user-designer dialogue concerning the meaning of applications are made explicit in practices of design which seek to empower the user. In the case of both participatory design (Ehn, 1988; Schuler & Namioka, 1993) and meta-design (Fischer, Giaccardi, Ye, Sutcliffe, & Mehandjiev, 2004; Fischer, Nakakoji, & Ye, 2009), the formation of a dialogue between designers and users previous to and continuing through any design work is seen as a central mechanism for building useful and socially-responsible applications (Bjerknes et al., 1987; Björgvinsson et al., 2010). In these, there is a specific value given to engaging in a dialogue around a design project in order for any application to best meet users' needs. While a similar mode of *meaningful* attention is recommended by an ethnographic method (Hughes, Randall, & Shapiro, 1993), in participatory design such dialogue is conducted specifically for the agentive involvement of users in a way in which ethnography is not (Crabtree et al., 2009). For some, design probes find a middle ground between the two (Boehner, Vertesi, et al., 2007; Gaver et al., 2004), as they seek to develop rich cultural understandings of user by asking future users to engage in creative and reflective considerations that can be be used by designers to understand their users in a rich way. By asking prospective users to creatively contribute to an understanding of their lifestyles and needs, they are given the opportunity to take an active role in considering what should be addressed in any application. Design probes, as a mode of dialogue between designers and users, allow users to provide their own insights into how they might engage in practices which make technologies what they are. Such a method seeks to establish a dialogue with
users that is previous to the kind of processional and situated interaction that is formed as
users engage with use (Button & Dourish, 1996; Dourish & Button, 1998). What is drawn out
here is the role that user dialogue plays in this developing sense of the important place that
immaterial social and cultural factors have in technology design today, both as it is
consciously attended to (as in participatory design and design probes) and as it develops
through use (as discovered through design probes or ethnographic work).

Indeed, these dialogic modes of design work take on an explicitly social and
immaterial character when the object of design is not to achieve the specific material aims of
work practices, but less substantial aims which rely on complex negotiations. In many of
these areas (such as modifying health behaviors (Dubberly, Mehta, Evenson, & Pangaro,
2010; Frost & Smith, 2003) and self-perception (Bers et al., 2001; Bers, 2001)), design seeks
to specifically address the ways in which a dialogue and commitment between users and
designers is able to achieve wholesale social change (Dubberly, 2008). With this vein of
social design in which the particulars of any artifact or system are secondary to the wider
social configurations produced, the intent is to develop a specifically dialogic coupling
between the work of designers and the way in which it is used in order to achieve a sort of
social re-configuration. The work of design comes to focus on processes of social
aggregation and the intelligibility made possible by such aggregation rather than the material
artifacts that may be recognized in the wake of such aggregation (as in the schema provided
by Latour (2005)). The goal of the design of the artifact comes to be secondary to the larger
changes sought to be established through the dialogic and continuing process of design such
as is found in modern conception of applications as services (Dubberly, 2008).

The question remains of how such dialogue functions and what its effects are,
particularly when designers are separated from their uses, either through the mobility of
much contemporary use or the distance afforded by Internet-based applications (Bødker,
2006; Crabtree et al., 2006; Long, Kooper, Abowd, & Atkeson, 1996; Miluzzo, Lane, Lu, & Campbell, 2010). That is, while dialogue with users may be the only way in which situational and cultural aspects of computing are able to be properly accounted for, when designers do not have direct access to users that they can speak with, how does such dialogue function? What does this kind of dialogue look like when it is conducted only through an already-developed application, fragmentary user feedback, and other particulate forms of electronic trace data (Goggins, Galyen, & Laffey, 2010; Goggins, 2012)?

Against Dialogue

Standing in contrast to this dialogic approach is a movement toward the utilization of personal knowledge of a design situation to guide design work. Highlighted by end user design and development that looks to provide tools to users who may have unique computing needs to be able to design their own applications (Fischer et al., 2004; Ko et al., 2011; Nardi, 1993), there is a sense that a suitable level of familiarity with the situation of use is difficult or impossible to attain for an outside designer. As with other approaches to interaction design following on the development of user-centered strategies, there is in this a sense that the user knows best and that, if a design is to properly match its intents, those intents must be, in some ways, innate to the designer. This can be seen in the type of personal knowledge that is to be generated through ethnographic approaches (Dourish, 2006, 2007) and in the kind of personal reflection that is part of being able to understand the cultural concerns of computing (Sengers et al., 2004). There is a sense that the work of designers is influenced by their experiences and knowledge of the world and that by subsuming the experiences of users into their own, designers can create better designs. This kind of personal, experiential knowledge is the site where, as discussed above, ethnographic and scenario-based designs strategies intersect, each deriving their experiences from different sources.
Taking such an approach in a more radical direction are those approaches to design and to design research that explicitly seek to account for this form of innate knowledge by eschewing the idea of external users at all, and instead choose to focus on the needs of the designers themselves (Neustaedter & Sengers, 2012). In these situations, there is a tacit claim that is important here. When designing for one's own use, the meanings and implications of an application are clear, and as such avoids any problems or mis-understandings that might be present when an application gets translated into its context of use (Muller, 2004). By already living within the social conditions that encourage and direct their use, designers are able to interact with the “materials” of their own needs directly. Such design work, as it comes into contact with the physical material of their design work (the code, the hardware, etc.), is immediately reflective of the conditions of use and the meaning that an application may instantiate.

What is central in all this is the key role that the intuitive power of the designer plays in design. Autobiographical and other approaches to design that seek to excise any external user from consideration serve to demonstrate that design is able to be generated through self-knowledge. At the same time it highlights the kind of meaningful understanding that is necessary when external users are to be considered. As the aims and uses of the technologies to be designed become more cultural, more social, and more intimate, the reflective work of designers who engage with these cultural, social, and intimate materials of their work remains centered on their understandings of these conditions of use.

This dual emphasis, focusing on both dialogue and on the innate acumen that must be developed by designers, points to the unique space in which the work of design occurs both specifically and as it unfolds across the general field of the engagement between the activity of design and use. Specifically, design can no longer be thought of as simply an engagement with the present materials of design, but that it instead be understood as taking place in a
shared and social world of cultures and values. In this, it is not centered on the bare affordances of an artifact, but on the meanings that are found and hammered out between designers and users. It is a process that is itself, like use, situated in a complex world in which designer, like users, are called on to reflect on their own experiences and histories.

It is this kind of lived understanding that takes place in the process of design, both in the dialogue and the monologue of it, that points further away from a cognitivist understanding of design, as was seen in some of the earliest considerations of interaction design (Card et al., 1983; Newell & Card, 1985) and toward a phenomenological framing of the question of design which differs from such information processing models in dramatic ways (Day, 2001; Dreyfus, 1979; McCarthy et al., 2004). Before examining the question of phenomenology in more depth, I will quickly look at the question of “big data” and the role that it serves to mediate the relationships between designers and users.

**Big Data**

Central to this developing picture of the contemporary relationship between designers and users is the explosion in the availability of user data (Barakova, Spink, Ruyter, & Noldus, 2013). These large sets of user data come to be the material in which users' attitudes and needs are represented and made intelligible to designers. User trace data (Østerlund, Sawyer, Ribes, Shankar, & Geiger, 2014), physiological data (Van Den Broek, 2013), and other sensor data (Alonso, Hummels, Keyson, & Hekkert, 2013; Terzis, Moridis, & Economides, 2013) all serve to build sets of “big data” about users and their use.

While there is no question of its impact, there is still “no clear consensus on what big data is” (Labrinidis & Jagadish, 2012, p. 2032). Despite this lack of agreement, it can be said for certain that the characterization of big data goes well beyond a simple account of the size of the data set. As the history of computing has shown, what may be defined as a large data set in one era appears insignificant in the next (boyd & Crawford, 2012).
In general, big data is defined not by just the *volume* of the data, but also by the *variety* and *velocity* of data (Hendler, 2013; Laney, 2001; Russom, 2011). The volume of the data can be understood as a characteristic of sheer size: the tera-, peta-, or exabytes of data present (Hendler, 2013) or the size of database tables or number of records (Russom, 2011). The variety of the data refers to the way structured and unstructured data might exist alongside semi-structured data and each other (Russom, 2011), with text data mixed in with video data. Finally, the velocity of data refers to the way in which the data in big data are collected from constant streams from sensors and online interactions. Velocity is what provides big data with its dynamic power (Gobble, 2013)—that it is able to be understood as representative of changing conditions of human activity.

As useful as the “three Vs” of big data (volume, variety, velocity) are for expanding our understanding of big data beyond a simple account of the sheer size of the data sets involved, such a high-level definition obscures the analytic work that goes into big data. As boyd and Crawford (2012) observed, “Big Data is less about data that is big than it is about a capacity to search, aggregate, and cross-reference large data sets” (p. 663). In this, big data is characterized by its complexity, with boyd and Crawford specifically proposing that the real definition of big data comes from our technological ability to analyze large data sets to achieve a supposed “higher form of intelligence and knowledge that can generate insights that were previously impossible, with the aura of truth, objectivity, and accuracy” (p. 663). As detailed by Ekbia et al (2014), the kind of complexity that is able to be handled by big data is out of the reach of the normal range of human analytic ability (Kraska, 2013; Weinberger, 2012), with the danger being that such volume of data begins to appear simply as noise (Wong, Shen, & Chen, 2012). This assertion is consistent with the sentiment that “the greatest shared challenge was not only engineering big data, but also doing so meaningfully” (Bizer, Boncz, Brodie, & Erling, 2011, p. 56).
In essence, big data “refers to enormous amounts of unstructured data produced by high-performance applications falling in a wide and heterogeneous family of application scenarios: from scientific computing applications to social networks, from e-government applications to medical information systems” (Cuzzocrea, Song, & Davis, 2011, p. 101). Just as there is an emphasis on the heterogeneity and volume of the data in big data, there is also an emphasis on the heterogeneity of uses and the different ways in which it may be leveraged and analyzed as it is put to work.

What needs to be emphasized here is that there is no one definition or characteristic of big data. All the various definitions, however, point to an amorphous set of conditions (an ever-changing definition of size, the kinds of analysis necessary, etc.) that are able to be called big data only by virtue of what we want to get out of them. Big data is made, in effect, by our relation to it, and is not anything ontological by itself. It comes into being through analysis. The task, therefore, is to understand the term “big data” as pointing to a tool that we use—and nothing else.

**Big Human Data**

What is central to the present discussion of big data is that this research is concerned with human data, which is distinct from the kind of data collected in the natural sciences. While one of the key advantages of big data in the natural sciences is that it is portable and once collected may be applied to numerous settings (Lynch, 2008), big human data—such as that collected in a MOOC or other instance of interactive use—faces the same challenge as other sociological data: It is open to the recursive effect of the impact that the data may have on the subjects of the data. Especially in the case of design work, patterns of behavior (as diagnosed through data analysis) that may be true today may not be true tomorrow following some design intervention (Carroll et al., 1991). Any data collected in reference to the use of a specific application remains largely connected to the specific site of its collection. In these
cases, the benefit that comes from big data is in the velocity of the data and the dynamic view into use that it is able to provide to designer.

As has been shown in disciplines ranging from biology to climate science to physics, big data has the potential to transform understandings and to revolutionize disciplines (Callebaut, 2012; Ekbia et al., 2014; Frankel & Reid, 2008; Mayer-Schönberger & Cukier, 2013). What is unique about using big data in the work of interaction design (and the domain of online education, in particular) is that the data collected provide a representation of human activities and understandings. In this context, big data is not about the natural world, but about us. What distinguishes interaction design's use of big data from the natural sciences’ use of it is that in the case of education, it is possible to intervene on the basis of conclusions drawn from the data.

Looking specifically at the kind of data generated by MOOCs, while some relatively stable and generalizable insights into low-level patterns of learning behavior (Cooper & Sahami, 2013) may be developed out of data collected from students, big data’s real value in education design comes in how it can be brought directly to bear on the educational processes instantiated in a system. Through its dynamic nature (or velocity) big data is able to continue to shape the educational experience of the very students who are generating the data. When big data is introduced into the process of designing online courses, it becomes possible to build courses around students, based on their individual experiences and data generated from the course being designed. As the data can be used to modify a course as it is being run, it becomes part of the experience of the course. Big data in education has a double nature: It simultaneously provides generalized insights concerning all students and offer specific insights into the progress and paths of individual students.

The fact that in these situations big human data is tied to the historical progression and situation of its collection reinforces the need to account for it in an phenomenological
manner. This kind of data does not just function as an ontic representation of the facts of the situation. Instead, it has the potential to play a dynamic and ontological role in the process of course design. Its importance is not in its ontic abstraction away from the wider world in which it is embedded, but in the way in which it is ontologically integrated into the whole of the process of design and use as found in online education. In its temporal aspects (both in terms of its velocity and possibility of recursive application), big human data can be leveraged by online course designers in an ontological fashion to alter the design of a course in a meaningful way.

**Phenomenology in HCI**

Driven particularly by epistemological developments that pushes the work of design away from the consideration of specific material artifacts and toward concerns around the establishment of social and cultural systems reliant on mutual understanding between designers and users, this next section will examine the uses of phenomenological theory in HCI research. With its links to both philosophical hermeneutics and deconstruction, phenomenology serves as the overarching backdrop for this research and provides an established link to existing design research. Phenomenology has been widely used in the theorization of use and interaction at a conceptual level, particularly as it conceives of users, designers, and their technologies as inhabiting a living world. Derived mainly from the philosophical work of Edmund Husserl (2001), Martin Heidegger (2010), and Maurice Merleau-Ponty (1962), phenomenology has been utilized in a variety of disciplines in order to rigorously describe and understand the way in which human beings engage with the world around them. Starting in a formalized way with the work of Husserl, phenomenology sought to diagnose the way in which individual consciousness approached the world from an intentional point of view. Husserl's phenomenological method was helped along by the development of the phenomenological reduction (*epoché*) which sought to bracket off any
assumptions made about an external world (Fink, 2003). Husserl's approach to phenomenology was radicalized though Heidegger's critique of the assumption of both an individual subject and external world. For Heidegger (2010), phenomenology came not to be a question of the correlation between an individual subject and the world, but one of ontological difference: the difference between individual beings and Being in general. While there is not space here to go deeply into the implications of Heidegger's disagreement with Husserl, it is enough to say that the question of the initial root and grounding of the ontological difference within consciousness is that which spurred on the development of Derrida's (2011) deconstruction. Through all these various developments and critiques of phenomenology, what remains important for interaction design is the embodied, contextual, engaged, and holistic viewpoint of human interaction with the world that phenomenology provides.

In computing, phenomenological approaches developed out of a fundamental consideration of how human beings interact with the world around them (Dreyfus, 1979) and how we may seek to design computer systems that are able to support and mediate these interactions (Button & Dourish, 1996; Dourish, 2004b; Suchman, 2006). Focusing on the way in which human understandings of the world are engendered by an active engagement with the world, phenomenology provides a unique theoretical and epistemological perspective for research.

In the study of computer design, phenomenology has been primarily used in one of two ways: first, as a theoretical support for a certain mode of interactions and second, as an epistemological rationale for interpretive methods used to study use and interaction. As noted above, phenomenological theory provides a basis for understanding the changing epistemic conditions in HCI research, particularly in its appreciation for the situated and embodied conditions of use (Dourish, 2004b; Suchman, 2006) and the kind of epistemic position
necessary for such an approach (Bleicher, 1982). This review of phenomenology in computing will inform the theoretical development approached by this research and will, in particular, address how the uses of phenomenology in this research differ from previous phenomenological approaches in HCI. As will be seen, these differences are primarily in the conceptual insights that phenomenology, and particularly a hermeneutic phenomenology, offers. These conceptual possibilities for this mode of research build on, and go beyond, the previous sensationalist, perceptual, and purely epistemological phenomenological approaches that will be reviewed here. In the focus on design as a form of meaning-creation between designers and users as shaped in their respective and common environments, the hermeneutic aspects of phenomenology come to be highlighted, with a phenomenological hermeneutics coming to provide a theoretical account of what goes on in design and how designers engage in the meaningful instantiation of new design ideas. In large part, this hermeneutic rendering of phenomenology is brought together with what has been seen as an analogous development in philosophy, deconstruction, particularly as both are focused on the question of interpretation (Michelfelder & Palmer, 1989). Deconstruction, as initially formulated by Derrida (2011), was first demonstrated as a kind of imminent critique of Husserlian phenomenology. What is presented in the following sections serves as initial ground to understand traditional uses of phenomenology in the study of interaction design. It is from this grounding that further phenomenological renderings of the conditions of big data and design will be developed.

Theoretical Development of Phenomenology in Computing

The use of phenomenology in the study of computing began in earnest with Hubert Dreyfus's (1979) early critique of artificial intelligence. Contrasting phenomenological understandings of human experience with more rigid Cartesian approaches which relied on a mind-body dualism, Dreyfus detailed the inability of early artificial systems to understand
the world with the same facility as human beings. What Dreyfus argued was that human beings, unlike computer systems, approach their interactions with the world from a concerned, motivated, and embodied position which sets up the conditions for the intelligibility of meaning. By having such a situated investment in the world, human beings, unlike computers, are able to apprehend and utilize a vast background of tacit information available about the world.

While these initial critiques were largely negative, early phenomenological insights into computing were also applied in a positive fashion, providing a framing for how computing could be integrated with human cognition (Winograd & Flores, 1986) and as a guiding criteria (based out of previous critiques) for further developments in artificial intelligence (Dreyfus, 2007). Mostly, however, the difficulties first identified by phenomenology in artificial intelligence led to an understanding that while there were certain aspects of computational tasks that computers excelled at, there were others that called for human intelligence. Such insight led to the push for computer designs that sought to properly integrate computer systems with human capabilities.

This understanding of how humans and computers worked together in a shared world proved to be a decisive insight as the paradigm and context of computing expanded (Grudin, 1990), particularly as the use of computing moved into the workplace, shifting from mainframes to personal computers. There, phenomenology lent both implicit and explicit support for studies of situated work practices (Ng, 2002; Suchman, 2006) that focused on how people interacted with computers, as well as for broader critiques of the role played by computing in the workplace (Ehn, 1988).

In particular, phenomenological ontologies provided a backdrop for early computer supported collaborative work (CSCW) research which, while utilizing other theoretical framings such as speech-act theory (Flores, Graves, Hartfield, & Winograd, 1988; Medina-
Mora, Winograd, Flores, & Flores, 1992), maintained a strong phenomenological-interactionist backing for their work (Schmidt & Bannon, 1992). This can be most directly seen in the manner in which CSCW utilized a Husserlian “lifeworld” in order to anchor human and machine interactions to everyday actions (Moran & Anderson, 1990). Such uses of phenomenology in HCI research led phenomenology to be characterized largely by a concern for the importance that everyday action, tacit context, and a holistic view of lived experience play in the ways in which human beings engage in meaningful interactions with other people, technologies, and the world at large (Robertson, 2002).

With the development of the idea of ubiquitous computing (Weiser, 1991), the phenomenological basis for understanding context became particularly important as researchers sought to understand the ways in which computing could become part of a tacit background of human experience (Dourish, 2004b). Even as some of the larger claims regarding to what extent computer applications could truly form a background of experience were challenged (Chalmers & Galani, 2004), phenomenology came to be seen as a leading theoretical basis for understanding how context in computing was able to be conceptualized (Chalmers, 2004; Dourish, 2004a; Svanæs, 2001).

Alongside ubiquitous computing, the development of tangible interfaces (Ishii & Ullmer, 1997) led to more developed ideas regarding the embodied nature of interactions (Dourish, 2004b; Millard & Soylu, 2009). Focusing on the physical and material relations that users can have with computers, embodied interactions sought to flesh out conceptions of users, moving further away from Cartesian divides between bodies and mind and toward a more integrated perspective of users situated in the contextual world (Mingers, 2001). Extending ideas of situated action, bodies came to be seen as important as minds when interacting with computers (Larssen, Robertson, & Edwards, 2006, 2007).
Methodological and Epistemological Expansion

The insight into the contextual and embodied dependencies of many computing tasks led to the recognition of the importance of engaging in phenomenologically-motivated and interpretive research into the use of computers (Button & Dourish, 1996; Dourish & Button, 1998; Suchman, 2006). Differing from experimental and laboratory studies of computing and even from other, positivist modes of contextual requirements-gathering, these research methods examined use under real-world conditions, aiming for a holistic understanding of users and how they engaged in computing and work activities toward an active creation of meaning through use. An outgrowth in the rise of user-centered computing design thinking, these approaches sought to broaden the field of inquiry into use away from simple, system-centered tasks and pushed for an understanding of how tasks were situated within a wider, very human context. Research methods such as ethnography and interpretive case studies sought to match phenomenological explanations of computing which emphasis the emergent and contingent nature of experience with a phenomenological epistemology which views knowledge as being embedded in a similarly-derived contextual and contingent structure. Differing from a positivist epistemology which treats empirical data as atomistic, objective, and innately true (at least in its most extreme, caricatured version), phenomenological and hermeneutic epistemology sees knowledge as being inter-subjective, contextual, and viewpoint-dependent (Bernstein, 1983; Bleicher, 1982).

Phenomenological epistemology looks to treat human knowledge as being, if not explicitly human (Derrida, 2011), at least tied in to the basics of human experience. This has led some to argue that the types of results expected from phenomenological research (ethnography and related methods in particular) are different from the results derived from other research methods and must be judged accordingly (Boehner, Vertesi, et al., 2007; Dourish, 2006, 2007). Such an epistemological position opened the door to the consideration
that the cultural milieu of design and use each play a role in technological practices and to the importance of embedding phenomenological-interpretive aspects in the design of systems (Sengers & Gaver, 2005; Sengers et al., 2004).

As phenomenology developed from a (relatively) simple theoretical frame for contextual inquiry of computing (as seen in its use in studies of work practices and CSCW) toward a full-fledged epistemological stance, it brought with it a third paradigm for HCI, one which relied more heavily on the interpretivist implications of context, embodiment, and situational understandings (Bødker, 2006). This new paradigm presented an epistemological challenge to the root purpose of HCI research, calling for computing to not just be suited to specific tasks, but to greater human concerns. In its phenomenological foundations (Bødker, 2006; Harrison et al., 2011), this new paradigm for HCI offers an integrated perspective of lived experience that shows how computer interactions may both implicate and be implicated by human concerns beyond those immediately present in use.

This move toward a more fully developed sense of user interactions and the ways in which interactions with technology can come to have a significant impact on the ways people approach the world has led to an emphasis on the possibilities of users’ “experience” of computing (McCarthy & Wright, 2004; Swallow, Blythe, & Wright, 2005; Wright & McCarthy, 2010) and the “felt life” of users (McCarthy & Wright, 2005). It is this connection between computing and a wider view of human experience that begins to show the possibilities for phenomenologically-derived research in HCI (Harrison et al., 2011) outside the formulation of technical requirements for design.

This turn toward interpretation in HCI (Sengers & Gaver, 2006) opened new possibilities for design research, with phenomenologically-influenced epistemological developments encouraging research into ethical (Robertson, 2006), emotional (Boehner, Depaula, et al., 2007), cultural (Blythe et al., 2010; Sengers et al., 2004), and even political
areas. From this laying out of the wide territory of investigation opened up by phenomenology, the contemporary realization of the use of phenomenology in interaction design will examined.

**Recent Uses of Phenomenology in HCI Design**

Despite these theoretical developments in the meaning for phenomenology in HCI research, much recent, explicitly-phenomenological work has fallen into one of two broad categories, neither of which seem to take full advantage of the possibilities offered by the expansive view given in phenomenological approaches. Most often, research explicitly engaging with phenomenology simply continues one of two trajectories already developed, either following the more blatantly theoretical approaches to physical and embodied interactions or the epistemological and methodological positions that have been laid out.

To start reviewing contemporary uses of phenomenology, first, there is continuing research into the embodied nature of technological interactions (Larssen et al., 2006, 2007). This can be seen most overtly in quasi-artistic work which seeks to explore various modalities of human-computer interaction, attending to physical and sensational aspects of the interfaces (Coffin, 2008; Motamedi, 2007). These present computing as explicitly taking place as a phenomena which humans interact with in an embodied and holistic manner. Most progressive in this regard is research pointing to the performative aspects of embodied interactions (Dalsgaard & Hansen, 2008; Fernaeus, Tholander, & Jonsson, 2008; Karoff & Johansen, 2009; Levisohn, 2011).

Related to this is the constant concern for the way in which computing, particularly of a ubiquitous nature, can be taken as a tacit background to other activities (Stienstra, Alonso, Wensveen, & Kuenen, 2012; Turner, 2011; Veerapen, 2011). These continued investigations into calm or quiet computing look to develop ways in which the use of computers can
surround people in personal and intimate ways (Bell et al., 2003). Reaching an almost political level, some modern studies of embodiment take up positions put forth by Don Ihde (1979) regarding the transformative layers which technology may inject into experience of the world (Fallman, 2007; Kocaballi, Gemeinboeck, & Saunders, 2010; Pierce & Paulos, 2011). Of recent work, it is those who merge an intersubjective understanding of embodiment with a strong phenomenological backing for their methods that seem to be taking fullest advantage of the developed possibilities of phenomenology in interaction design (Coffin, 2008; H. Kim, 2011; Stienstra et al., 2012), disclosing the relations between intentionality, design, and interaction in their work.

Second, phenomenological epistemologies continue to be leveraged in opposition to positivist research practices. While sometimes utilized in order to achieve a match between phenomenological and embodied approaches to understanding use (Light, 2007; Ní Chonchúir & McCarthy, 2007), interpretive and phenomenological epistemologies continue to be used in the study of other (non-phenomenological) approaches to computing as well (C. Bates & Yates, 2008; Kwon, Smith-Jackson, & Bostian, 2011). However, even when phenomenology is not explicitly utilized as a theoretical framing for research, phenomenological and interpretive epistemological methods are still seen when examining areas that would easily, were it the author's goal, fit with other explicitly-phenomenological work given an emphasis on topics such as emotion (Sloan et al., 2011), group negotiation (Pommeranz, Brinkman, Wiggers, Broekens, & Jonker, 2009), and the intuition associated with skilled behavior (Trotto, Hummels, & Restrepo, 2011).

Taken together, these two uses of phenomenology—as theory of interaction and use, and as epistemology—continue to influence research which seeks to understanding computer interactions not as closed circuits of purely mechanical exchange between users and systems (Day, 2001), but rather as parts of a wider lived experience, one that needs to be interpreted.
as much as documented. What they do not do is push further into the working of phenomenology in order to examine the meaningful implications of design interactions. In this, there remain many opportunities for the expansion of a phenomenological program in understanding HCI design.

**Possibilities in Phenomenology**

While certainly sympathetic to both the epistemological and the theoretical uses of phenomenology described above, the aim here is to examine the interpretive conditions and processes involved in the work of design itself. In this, I am explicitly not concerned with the conditions of use of an artifact (whether such an artifact would be understood from a phenomenological perspective or not), nor with the phenomenological epistemology at the foundation of interpretive research (as much as this work may incorporate interpretive methods). Instead, I aim to bring to light the basic, hermeneutic function of phenomenology as it is present in the interpretive movement of HCI design work itself and how such work makes use of and engages with large sets of user data. Aspects of each (embodiment and epistemology) do nevertheless continue to exert influence, particularly in the guise of concerns for familiarity (Turner, 2013) and the epistemic conditions of design work itself (Harrison et al., 2011). However, while other research has approached questions of design dialogue and user data analysis through particularly humanistic approaches (Wright & McCarthy, 2005) or has examined design work through a particularly materialist lens (Dearden, 2006), this work is targeted at a more fundamental level concerning the phenomena of design and use as they pertain to the basic possibilities of shared phenomenological intelligibility (Heidegger, 2010). In this, I look inwardly at the process of design as a specific mode of meaning creation (Carroll & Kellogg, 1989) so that a phenomenological account of the activity of design itself and its engagement with user data can be developed.
To do so, the hermeneutic phenomenology of Martin Heidegger (2010), Hans-Georg Gadamer (2004), and Gianni Vattimo (1997) and the deconstruction of Jacques Derrida (1997) will be utilized in order to understand the process of interaction design as it exists today in the context of large scale data. While Heidegger's phenomenology has proved to be foundational for the use of phenomenology in HCI (Chalmers, 2004; Dourish, 2004b; Weiser, 1991; Winograd & Flores, 1986), the exact mechanisms of hermeneutic functions as they may apply to computing in general (or more specifically to design) have been neglected. This neglect has not been without reason. Looking at the development of phenomenological viewpoints in studies of computing, phenomenology has been leveraged most in instances in which a robust description of human practices is necessary (Ehn, 1988; Moran & Anderson, 1990; Schmidt & Bannon, 1992). Phenomenology has in large part (and not entirely incorrectly) been utilized as a code word for holistic approaches to contextual concerns of computing that highlight the robustness of human experience. What has not been done with phenomenology as it relates to computing is to productively disclose how this holism of the disclosure of human meaning in design functions, something which is necessary when looking into the productive nature of design work. In particular, this research looks at the basic phenomenology of the work of socio-technical design in the context of large scale data in order to draw out its basic movements and trace their implications.

**Research Themes**

Reviewing the literature concerning HCI design, dialogue, big data, and the theoretical frame of phenomenology, several directions of inquiry are developed in order to guide the research that follows. Primarily, though not exclusively, they each roughly correspond to the chapters which follow:

- First, the question of the nature of the work of design is addressed: How do designers meet the various conditions necessary for design, both material and immaterial? In
this is a fundamental consideration of the nature of design work itself, particularly as it approaches the question of values, culture, and other broad sociological determinations.

- Second, there is the question of the uses and influence of large scale data in the work of interaction design: How does the presence of large scale collections of user data affect the work of design? How is what had previously been empirical research in service of understanding users transformed as the scale of the data utilized increases?

- Third, a question regarding the uses of data in the work of design is addressed, deepening the consideration of the material import that such data can have in providing designers a direct relationship with their subject users.

- Fourth, in the context of MOOCs, what kind of picture develops out of student data that drives the work of design? Through this question, a typology of critical incidents is developed based on the empirical analysis of a large set of student data collected from MOOCs.

- Finally, the overarching question of the relationship between phenomenology and the developing relationship between big data and design is addressed. This vein of inquiry serves to deepen the considerations of phenomenology as they touch on the relationship between design and data.

These five orienting themes of this research, while being addressed primarily in the order they are presented above are present, in some way, in all that follows. Shot throughout all of these questions is the persistent inquiry into the kind of relationship that develops between designers and users through the medium of the data produced in the online course. Most basically, the chapters that follow are guided by the question of how large scale collections of
user data transform the work of interaction design and the relationship between designers and users.

In particular, these questions cluster around the rising importance of the immaterial aspects of computing (values, culture, etc.) that lay beyond (but are bound up in) the artifact itself. These social and cultural aspects raise the issue of the way in which users come to understanding the technologies that they use—both in terms of how to use something (as in the older definition of HCI design work) and what are the implications of the use of an artifact. More importantly for this research, however, is the analogous question of how the work of a designer engages with large sets of data in order to make the meaning of an artifact (and therefore also the meaning of the user) intelligible. This concern for the intelligibility of an artifact, of how it shows itself within a wider world than even the conditions of its immediate use, drives questions surrounding the way in which designers and users each in their own way come together to make an artifact meaningful.
The continuing rise of interest in both traditional online education and new forms such as massive open online courses (MOOCs) raises questions for educators (Bennett & Lockyer, 2004; Fleming & Becker, 2007; Logan & Froehlich, 2007), administrators (Byerly, 2012), and technologists (Berg, 2000; Russell et al., 2013) alike as they grapple with the meanings and forms surrounding these relatively new educational paradigms (Allen & Seaman, 2011, 2013; Dutton, Dutton, & Perry, 2002; Harasim, 2000). In many ways, these challenges mirror similar challenges faced by those working in interaction design, including those specifically working to design systems for online education. The challenges occasioned by the surge of interest in MOOCs offers an opportunity to consider a number of novel concerns regarding the role of traditions of education, use, and the institutional apparatuses that support and constrain innovation. For both disciplines (and particularly, though not exclusively, higher education and online interaction design), a flood of users and data poses questions of both scale (Cramer, Rost, Belloni, Bentley, & Chincholle, 2010; Hickey, Kelley, & Shen, 2014) and audience (Dutton et al., 2002; Fuchsberger, Nebauer, Moser, & Tscheligi, 2012; Ingram, Ou, & Owen, 2007), challenging established methods for both socio-technical modes of interaction design (Dubberly, 2008; Norman, 2010) and online education (Bovill et al., 2011; Tsai, 2010). In each, the meanings of long standing concepts are reconsidered (Day, 2011; Dubberly, 2008; Harasim, 2000) and the shifting of the values and categories which have defined their work becomes starkly visible. At their center, each is propelled by competing discursive and ideological movements which look to define and establish a future
course for their work (Elliott & Kraemer, 2008; Kling & Iacono, 1988; Njenga, Cyril, & Fourie, 2010; Ravid, Kalman, & Rafaeli, 2008).

Still at a nascent stage of development, the specific challenges for the development of MOOCs have yet to be concretely identified outside of the broadly-cast questioning over their potential function (as in research regarding the potential for large-scale peer-assessment (Kulkarni et al., 2013), for instance). As with most innovations in education, online education (and MOOCs in particular) raise questions surrounding the purposes, values, and future of education (Hiltz & Turoff, 2005; K. Kim & Bonk, 2006; Mitchell, 1999; Petre & Shaw, 2012). In their engagement with a wider-than-disciplinary field of action, these questions for education align with an understanding of interaction design which links the use of technological systems to wider social structures. The reliance of MOOCs on technological development (particularly in their reliance on the Internet) presents a unique challenge in that they bring traditions of interaction design into close proximity to the established practices and traditions that surround education (Berg, 2000; Volery & Lord, 2000).

In this collision of concerns, the vision of the function and organization of online education presented here is largely reflective of the larger aims of the development of a broader information science: how can the study, use, and function of information and information technology be conceived of as a multi-faceted and unifying discipline (M. J. Bates, 1999; Bawden, 2008)? Without discounting or marginalizing the importance of specific discourses of education (a tendency which has been argued against (Ascough, 2002)), this chapter advocates for the consolidation of the concerns of online education under a rubric of radically-considered discourse of technology and interaction design. That is, it is argued that by framing any discussion of the development of values, meaning, and concepts in online education first as one of technology design, it is possible to better address the
particular concerns of education within the sphere of technology and interaction design. As will be detailed, by approaching this challenge from a technological perspective, designers and educators are able to take advantage of well-established and extensible approaches to design that account for the variability of the developing situations and concepts surrounding education, while accounting for a certain non-teleological picture of technological effect that will be developed here.

Understood in this way, the aim to give theoretical framing to the entire negotiation of the values, meanings, and concepts in the design of online education and the networks of political, economic, institutional, and historical forces at work in their definition. By focusing on the question of a technologically-founded practice of interaction design rather than these broad and complex networks of influence, I start by immediately attending to the phenomena of what makes online education what it is (as instantiated through the practice of interaction design) rather than starting with the rhetorical positions that surround it.

Here, the question of how to understand interaction design is, above all, an ontological question and one that serves to orient this research in a philosophically ontological manner (Fonseca, 2007). In this, there is concern for the fundamental question of what design is, something that is motivated in large part by the desire to gain insight into the pressing questions that are developing around the increasingly important role that design plays in our society (Norman, 2010). Starting the formulation of an understanding of the work of design as being an event of the confluence of technical and social needs, the concept of “general technological practices” will be developed as a means to understand the instantiation of values in the context of online education.
Understanding Design

As introduced in the previous chapter, an often-cited (Carroll, 1997) starting point for understanding design in information sciences comes with the definition of design given by Herbert Simon (1969) as any course of action “aimed at changing existing situations into preferred ones” (p. 55). This definition is reinforced by Lois Lunin (2009) who in defining design says that it “can be defined as the combination of both the vision and the plans to realize the vision” (p. 1942). These definitions both highlight the double, quasi-dialectical ontology at work in information science-based discussions of design. Lunin's definition does this most overtly, with Simon's definition needing slightly more analysis in order to draw out the dual proposition of design which addresses both preferred situations and the conditions for change. In both, there is a sense of the need for, as Lunin calls them, both vision and a plan to realize that vision: for a designer to have an idea and the technological means to make that idea real.

This two step work of design, comprised of both an intent or idea and the means to effect that idea, comes to be the hallmark of information science, particularly given its progressive and evolutionary stance. As will be developed, these two impulses interact to form the ontological domain of design in information science.

The Social-technical Gap

Working in the area of computer-supported cooperative work (CSCW), Mark Ackerman provides a useful model for beginning to understand this dual nature of design—albeit one that is not directed toward the present question. Looking at the “fundamental mismatch between what is required socially and what we can do technically” (p. 198), Ackerman (2000) diagnosed what he termed the “social-technical gap” looming between what is necessary and what is technologically possible. While human beings are nuanced,
flexible, and often ambiguous, technological systems, if they are to function, are not. In formulating this, Ackerman established a theoretical distinction in CSCW between what is technologically possible and what is humanly required. For Ackerman (2000), it is this social-technical gap that gives CSCW its theoretical motivations and “although it certainly can be better understood and perhaps approached” (p. 198), this gap is unlikely to be done away with entirely.

Ackerman (2000) defends this understanding of the social-technical gap against two symmetrical charges that seek to diminish its importance. The first is that “the social–technical gap will be solved shortly by some new technology or software technique” (p. 189). This can be, quite obviously, considered to be the technological solution to the gap, while the second, that "the gap is merely a historical circumstance and that we will adapt to the gap in some form" (p. 189), is obviously aligned with a social or human amelioration.

What is interesting about each of these critiques—both of which Ackerman answers easily and in doing so provides a convincing case for the permanence of a social-technical gap within CSCW—is that they are both couched as historical and progressive steps toward the elimination of the gap that exists in current human uses of technology. That is, they are concerned with socio-technical design at large, extending beyond the immediate conditions of use that Ackerman addresses. Within this historically-developing and progressive setting, there remains a naggingly-present mismatch between the subjective and responsive needs of users, and the more staid (though still changeable and changing) artifacts of technological design. Ackerman’s explication of such a gap highlights the continual mutual adjustment that goes on in fitting technology to a situation.
The Situation of Design

The model of the gap that exists between potentially unlimited needs and the finite conditions of technological possibility is a theme that can be seen more generally in the work of Hans-Georg Gadamer (2004) and his consideration of the hermeneutic nature of understanding. Central to this is a mode of fore-understanding necessitated by the hermeneutic circle, with understanding only being possible based on an already-existent (historical or traditional) understanding. For Gadamer, understanding is only ever developed on the basis of the particular historical situation of the interpreter. As he puts it, “[u]nderstanding is, essentially, a historically effected event” (p. 299). As he develops his hermeneutic view of historical understanding, Gadamer works against the idea that it is possible to ever wholly take on someone else’s understanding, and asserts that any interpretation is founded on the particular situation under which it is enacted.

This situational and temporal view of understanding can be applied directly to the socio-technical gap in several, complementary ways. Most directly, the gap can be seen as attempting to acquire an accurate picture of use so that design work may be properly addressed.

In their Understanding Computers and Cognition, Winograd and Flores (1986) quote Gadamer on the difficulty of attempting to provide an accurate depiction of the situation of use:

To acquire an awareness of a situation is, however, always a task of particular difficulty. The very idea of a situation means that we are not standing outside it and hence are unable to have any objective knowledge of it. We are always within the situation and to throw light on it is a task that is never entirely completed. (Gadamer, as quoted in Winograd & Flores, 1986, p. 29)
While, according to Vera and Simon (1993), Winograd and Flores use Gadamer's assertion to place particular emphasis on the difference between acting in ill-structured, real-world situations as compared with well-structured, defined situations, arguing that symbolic approaches, even if they take account of the bounds of human rationality, cannot handle ill-structured situations adequately, (p. 12)
a more fundamental issue beyond their concern for an ontic environment of action (and one more directly related to the practice of design itself) is at stake.

In describing the concept of the situation, Gadamer provides an account of epistemic difficulty that resonates with Ackerman’s gap between what we know we should provide and what we are able to provide. Saying that we “are unable to have any objective knowledge of [the situation],” Gadamer attends to a more formidable difficulty beyond concern for unstructured needs and structured solutions. Just as where in the socio-technical gap there is an inability to match human, subjective needs with the affordances of an objective system, it is the task of hermeneutics “to consider the tension that exists between the identity of the common object and the changing situation in which it must be understood” (Gadamer, 2004, p. 308). In their hurry to offer means to close the socio-technical gap under the rubric of progress (either social or technological), Ackerman’s critics (largely imagined and rhetoric in the context of the original paper) instead reinforce the gap in a more fundamental way: the constant shifting of needs and technological means over time simply turns an ontic consideration of the gap (that of the practical question of proper fit) into a more ingrained and ontological gap in understanding as found in Gadamer’s hermeneutics.

Of course, for both Ackerman and Gadamer, the challenges posed by a separation between need and technology or between object and interpretation are not insurmountable,
but are instead largely productive. For Ackerman (2000), the explication of such a gap is itself important in refocusing research toward “[e]xploring, understanding, and hopefully ameliorating this social-technical gap” (p. 179). For Gadamer (2004), the “true locus of hermeneutics is this in-between” (p. 295). Similarly, for each, the distance discovered does not close off possibilities for research, but instead opens them up. Gadamer, in particular, in his consideration of the human sciences, sees the uncovering of this kind of limiting structure as immensely important and generative:

Every finite present has its limitations. We define the concept of “situation” by saying that it represents a standpoint that limits the possibility of vision. Hence essential to the concept of situation is the concept of “Horizon.” The horizon is the range of vision that includes everything that can be seen from a particular vantage point. Applying this to the thinking mind, we speak of narrowness of horizon, of the possible expansion of horizon, of the opening up of new horizons, and so forth. (p. 301)

This concept of the horizon is the locus of how Gadamer’s approach to the tension between two settings is productive, with the task of hermeneutics being found “in not covering up this tension by attempting a naive assimilation of the two but in continuously bringing it out” (p. 305). Putting this in terms of the social-technical gap, the challenge is to not naively bring certain needs together with a solution, but to instead fuse the two perspectives by a hermeneutic dialogue between the different horizons of experience that they represent.

“Projecting a historical horizon,” Gadamer reasons,

is only one phase in the process of understanding; it does not become solidified into the self-alienation of a past consciousness, but is overtaken by our own present horizon of understanding. In the process of understanding, a real fusing of horizons
occurs—which means that as the historical horizon is projected, it is simultaneously superseded. (p. 305-306)

In the context of Gadamer’s hermeneutic phenomenology, the interpretive processes that mirror and give shape to this developing link between social needs and technological solutions necessarily have a grounding in the common basis for interpretation that he poses:

When our historical consciousness transposes itself in historical horizons, this does not entail passing into alien worlds unconnected in any way with our own; instead, they together constitute the one great horizon that moves from within and that, beyond the frontiers of the present, embraces the historical depths of our self-consciousness. Everything contained in historical consciousness is in fact embraced by a single historical horizon. (p. 303)

Such an approach is closely tied to Gadamer’s insistence that the weight of traditional understandings bears heavily on any present interpretation, and that there is, despite whatever difference may be felt at any particular moment, one common core to any sense of “truth” can be achieved through philosophical hermeneutic reflection (Bernstein, 1982). That is, our needs and technological offerings are linked by a common tradition of use and design.

**The Ontology of Design**

While maintaining an *a priori* separation between human needs and the technological answers to those needs is a useful approach to understanding the ontic theoretical problem-space of information science and design, such an approach proves difficult in providing an ontological account of the work of design. While Ackerman's social-technical gap provides a useful orientation for CSCW and gives ontic import to the theoretical work in the field, its stark division between technology and human needs is not ontologically viable for understanding the role of design in information science. Which is not to say that that is its
purpose. Ackerman's gap describes the immediate space of what is needed out of technology—for technology to satisfy needs as a singular theoretical whole—but does not set the question of the match between technology and need within a more fundamental framing of the ontological relationship between human beings and technology that extends beyond the moment of use and to the moment of design. The model of the social-technical gap (as does a technological reading of Gadamer’s hermeneutic approach) struggles to understand the activity of design as it is spread across the situations founded by use and the situations founded by the technological artifacts involved. While each point to, neither provides an ontological account of the enaction of the possibilities offered.

Despite any specific difficulties, an approach which isolates human need from technological capability under the banner of the general requirement of satisfaction does provide a useful beginning to understanding an ontology of design in information science. Following such an approach, the component parts of design—technological means and intent—will be examined individually.

**Technological Possibility**

Simon (1969) provides a good place to start in order to understand the role of technological possibility in design, particularly in that his conception of design is almost purely technical. While including the idea that the goal of design is to “make artifacts that have desired properties” (p. 129), he excludes this sense of imperative from his formal description of design, making it almost wholly about the question of optimization toward a goal. In judging success, the benchmark is always, “does the system designed create the desired change?” The technological branch of information science design is one of effectiveness that is couched in the ability to set up systems that do what one wants them to do. In online education, for example, the question of the technical ability to communicate a message from one place to another (where the question is of whether the message arrived or
not) is wholly different from the question of what the intent or motivation, in terms of educational goals, seeks to accomplish. The former would be a question of technological possibility, while the latter is of (as will be discussed in the next section) ethical intention.

In its basic appeal to what is technologically feasible, this sense of possibility has an almost universal and positivist character. If such a technological system is able to accomplish what it does for one person, it will do it for another. So, in the example of online education, what can be understood as being technologically universally possible is the fact that a message can be communicated using online tools. This says nothing about whether it will accomplish any particular educational aims. This mode of technological possibility exists independently of any cultural value or intent. In many ways, such an account begins to reinforce Ackerman’s social-technical gap, showing an unbreachable divide between human needs and technology, albeit under different terms and conditions, and with different implications.

Gadamer (2004) too distinguishes between this kind of “technical” application from other types of application, saying that

[i]t is not only that moral knowledge has no merely particular end but pertains to right living in general, whereas all technical knowledge is particular and serves particular ends. Nor is it the case simply that moral knowledge must take over where technical knowledge would be desirable but is unavailable. Certainly if technical knowledge were available, it would always make it unnecessary to deliberate with oneself about the subject. Where there is a techne, we must learn it and then we are able to find the right means. We see that moral knowledge, however, always requires this kind of self-deliberation. (p. 318)
The limits of technical knowledge, of the object of technology, then comes to be understood in contrast with moral knowledge, which “can never be knowable in advance” (p. 318) and “has to respond to the demands of the situation of the moment” (p. 319). What Simon's (1969) account of design leaves out when describing design work as being concerned “with devising artifacts to attain goals” (p. 133) is an explanation of how to determine “how things ought to be” (p. 133). That is, for design in the context of emerging paradigms (such as something like online education), there is, beyond any technical accomplishment, a fundamental question concerning the purposes and modes that should be instantiated in any technological design.

**Ethics and the Intention of Design**

As the development of a concern for culture and human perspectives within information science has shown (for example, (Ehn, 1988; Kling, 2007; Suchman, 2006)), the question of what should be done technologically under any particular circumstances is an important one. In many ways, the basic question of information science once the question of technological efficacy is momentarily suspended comes very close to Aristotle's (1998) original question concerning ethics: of what to do in order to live a good life. In framing his ethics, Aristotle was not concerned with a basic question of whether or not any discrete action is ethical or not, but rather with what should be done in order to achieve a good life. At issue here is a consideration of what types of activities one should invest their time in and how we should judge the outcome of any effect of our efforts. Looking beyond Simon's explication of design, when viewed from the position of an Aristotelian framing of human action, there is a distinctly ethical component to information science design. It is only once our goals and values have been examined and we have decided what should be done that we are able to design technological systems to achieve those things.
Diverging from the picture of technological possibility as described in the previous section, this ethical question of what to do is not universally answerable. What is good for one person in one moment may not be good for another. More than just appealing to a sense of individual or cultural determination, this heterogeneity of ethical intent and desire is one that is situationally and historically derived. At its center, this kind of ethical variety is consequential particularly in the way in which it is subject to Gadamer’s concept of the situation of interpretation: that the circumstances and terms of any ethical consideration are always only able to be approached from an insular and situational perspective.

While ethics in design has been discussed in many ways (Brey, 2000; Floridi, 1999; Friedman et al., 2006; Winner, 1980), we are not concerned here with the possible representation of any particular ethical system, but instead with a general inducement toward action that an Aristotelian consideration of ethics brings. What is of interest here is the way in which technological possibility interacts with the basic question of “how to live” and thus contribute to an ontology of information technology design. Neither the question of ethical intent nor the question of technology, however, is limited to to such a singular consideration, and each (when starting from such an a priori distinction) needs to be subject to a double consideration: first in their initial formulation (as technology and as intent) and then again when brought together in the activity of design itself. That is, when understood in an ontological fashion from an initial divide between intent and technology, each aspect (the moral force of the technological action and the materials involved) must necessarily be considered twice.

**Ontological Doubling of Design**

What is seen in the ontological constitution of the field of design in information science is a progressive interaction between these two distinct impulses: the technological and the ethical. In their inextricable connection and following on the theme developed by
Gadamer, the two take on the character of the hermeneutic interplay between figure and ground (J. Martin & Fonseca, 2010). In traditional forms of hermeneutic textual interpretation, the meaning of a particular passage is interpreted based on a reading of the whole of the text (Grondin, 1994). The whole of the text (the ground) invests the particular portion (the figure) with its meaning and vice versa. Here, on the one hand, technological possibilities offer a field on which we are able to articulate the figure of our ethical ambitions, and on the other, our ethical ambitions serve as the field against which we derive technological innovations.

Central here is that the ethical goals set in the process of design and current technological capabilities are each, and in their own ways, determinate of the ontological field of design in information science. Each are progressive and evolving, and following the figure of the hermeneutic circle, change over time in each instance of design. In this, the kind of ontological understanding that is developed in this hermeneutic process “proves to be an event” (Gadamer, 2004, p. 308).

The Event of Design

As has been described above, as a progressive and ever-changing field, the work of design comes to rely on the logic of the event in order to provide an ontological account of its development. Coming out of various veins of post-structuralist philosophy (Badiou, 2007; Deleuze, 1990; Derrida, 1995), the logic of the event focuses on the absolute uniqueness of certain sets of occurrences. In the present use of the term, “event” explicitly means that which is not typical or universal and finds some lineage with Heidegger's Augenblick in which “[t]he singularity and uniqueness of the moment is a crisis calling for an individuating decision and resoluteness in response to the situation” (Nelson, 2007, p. 103), as well as with Gadamer’s (2004) consideration of the phronetic instance of legal judgment in which “every law is necessarily in tension with concrete action” (p. 316). That is, such a moment cannot
rely on general prescriptions for action and instead pushes them away. It is a “dynamic and unstable moment” which “destabilizes pre-existing concepts and habits, even while it evades and resists normalization and being subsumed under categories, classes, and universals” (Nelson, 2007, p. 103).

In this, design, as it is comprised of the moment of ethical decision against a backdrop of technical possibility (and vice versa), takes on a unique ontological character. It is not simply the progression from human needs toward technological fulfillment, but it is a unique and eventful moment in history which comes to be in the interplay of our ethical decisions (in the Aristotelian sense) and the material possibilities of technology. It punctuates the otherwise constant progression of information science.

This event, as such, revokes previous considerations and presents a new historical situation (in the Gadamerian sense) to the designer involved. This new situation is unique from anything previous, and accounts for the mode of innovation or newness that is found in design (Bødker, 1998). In Derridean (1995) terms, this new situation, as the eventful confluence of ethical intent and technological possibility, becomes a kind of *mysterium tremendum* in that “[e]ven if one thinks one knows what is going to happen, the new instant of that happening remains untouched, still unaccessible, in fact unlivable” (p. 54). Above and beyond the mode of hermeneutic interaction of intent and technology that is seen in producing the event of design, there is a further step required, one that is necessary in order to frame the work of design in a temporal and evolving setting such as presented by information science in general.

**Integration and Hospitality**

In looking at the eventful interaction of the dual impulses of design, it is useful to consider a conceptual position introduced to information science by Claudio Ciborra (1999, 2004) as a way to re-orient the ontological understanding of information system design and
organizational integration (Brigham & Introna, 2006). Also focusing on a mode of design work, Ciborra approaches design from a less immediate position than here, and attends to wider, more systematic concerns. Nevertheless, examining the relationship between technological artifacts and organizations, Ciborra uses Derrida’s (2000) concept of hospitality to re-figure the relationship between existent organizational practices and practices that are introduced by a new technology. The concept of hospitality, for Derrida, relies on a radical acceptance and openness to the coming of a stranger. The stranger, in being appropriately welcomed, is treated as equal of the host, given the same rights and opportunities as the host, all the while still remaining only a guest: “The guest becomes the host’s host. The guest becomes the host of the host” (Derrida & Dufourmantelle, 2000, p. 125).

For Ciborra, while this logic of hospitality provides an insight into how information system design should approach the integration of a new technological system into an existent social one, what is important for us is the ontological picture of design that it provides. In looking at the event of design as occurring with the interplay of technological possibility and human ethical intent, it is possible to first see the way in which each of these discrete impulses welcomes the other, while still each remaining distinct. Just as it would be impossible to imagine any form of information technology (as material artifact) to exist without some motivating human intent, neither would it be possible for human intention toward information (whether considered traditionally technological or not) to exist without the object on which it can project that intention (Day, 2011). In both cases, the one opens itself completely to the other.

While this largely follows the already-discerned hermeneutic structure of the interaction of figure and ground, there is one distinct difference between the kind of interaction that is present in Gadamerian hermeneutics and the picture of hospitality drawn out by Derrida. Whereas the case of hermeneutics is predicated on the necessity of some pre-
given tradition on which to build an interpretation (as in the case of the interpretation of the law by a judge), Derrida's (2000) “unconditional law of hospitality, if such a thing is thinkable, would then be a law without imperative, without order and without duty” (p. 83). In this scenario, such unconditional logic is what allows for any kind of newness or innovation in the work of design to appear.

More importantly than just providing an alternate and more immediately progressive picture of the interaction of intention and technology found in hermeneutics, the mode of disjunction seen in the concept of hospitality gives shape to the nature of the event of the interaction between the two as well as the kind of innovative and progressive newness that design brings. As Derrida (2000) describes it, “absolute hospitality requires that I open up my home and that I give not only to the foreigner . . . but to the absolute, unknown, anonymous other” (p. 25). That is, there comes to be a decisive acceptance of the result of the conjunction of the initial event of design; when confronted with the unexpected and heretofore unknown conjunction of the ethical intent of design work and the technological materials of it, there is an ontological necessity that such an event be welcomed, even as it may be unknown. Where hermeneutics provides support for the initial interaction of technology and intent, it is this logic of hospitality that provides the dis-locative doubling of the event of design.

In this ontological picture of design in which technological possibility comes together with ethical intent in an event in which each opens itself to the hospitality of the other, design achieves a fully historical and situational character. The decisions of design concerning this mode of hospitality become, for designers, truly ethical decisions: “ethics is hospitality” (Derrida & Dufourmantelle, 2000, p. 17).

In Derrida’s (1995) account of the moment of ethical decision, such decision is that which cannot be planned out in advance. If one were able to decide before the occurrence of
an ethical decision what the correct decision would be, then such a decision would not in fact be an ethical one. It is this inability to prescribe the outcome of any ethical decision that leads design as whole toward a logic of the event and hospitality. In this temporal contingency in which designers are faced both with judgments of ethical intents previous to the event of design and in the event of design itself when such ethics comes into relation with technological possibility, design takes on the character of a doubly ethical moment. Design becomes strung between these two moments of decision.

II

The Case of the Event of Values in Online Education

With this ontological model of the eventful work of design in mind, it is possible to turn to the concrete situation of design within the context of online education and further explicate the dynamic relationship between the technological and ethical impulses of design. In particular, it becomes possible to look up from the quasi-fundamental position developed above and see how the constitution of values in online education can be conceptualized through what will be termed “general technological practices.” As will be developed, this system of general technological practice allows for the consideration of the development of values in education within a wholly technological frame that builds up in a reverse movement from the ontological picture developed above.

Technology and Education

Looking back at the history of online and distance education (Harasim, 2000; Larreamendy-Joerns & Leinhardt, 2006), it becomes apparent with each reformulation of the media of education and the necessary reductions of the field that are made in order to fit it to a new paradigm (Gedik, Hanci-Karademirci, Kursun, & Cagiltay, 2012), that any technological reformation leads to the reevaluation of the aims (Garrison, Anderson, &
Archer, 2003; Hiltz & Turoff, 2005; Mitchell, 1999) and central concepts of education (Harvey, 2002). This is not to immediately call for a link between educational philosophy and technology, nor is it to preach some version of technological determinism as has been critiqued (Njenga et al., 2010). Rather, it is only to highlight the effects that the changing context for education can have on how it thinks about itself, technology being one contextual and linked aspect in a long chain of political, historical, and economic determinations.

Perhaps more than any discussion of the aim or spirit of education, these technological transformations press questions of the value (both economic (Petre & Shaw, 2012) and moral (Mitchell, 1999)) of various approaches to education. For example, the value given to educational approaches such as distributed knowledge building is dependent on the technological means available to support it (Gedik et al., 2012; Ravid et al., 2008). While not arguing here for a direct link between certain technologies and certain values, new technologies (it is hoped) make possible modes of education not previously possible, and in their technological amelioration of certain problems in education, new aims can develop. In this, there is friction (though not necessarily in an adversarial sense) between both the different modes of education employed as well as the differing aims that are expressed by each of the forms. MOOCs, in particular, challenge a wide set of fundamental values in education, including epistemic and institutional authority, the ancillary value given to specific educational systems (such as the modern university system), and the basic concept of classroom-based learning.

The most basic mode of conceptual development at work in the design on online education relates to the determination of the purposes and values that should be associated with educational enterprises (Hiltz & Turoff, 2005; Mitchell, 1999). In the design of online education, each step in the process serves, in whatever small way, to construct a sense of
these values and purposes in material (if only digital) form. The concepts, values, and categories that are used (perhaps tacitly) in the design of new systems of education are embedded as much in the analytic discourses surrounding the technologies as in the technologies themselves. For online education moving forward, it is imperative that these values, concepts, and the methods and discourses surrounding their development are understood in a manner which provides not only practical, but also theoretical value to the work of technological design on which it relies.

**General Technological Practices**

For online education, one of the central features that distinguishes it from other considerations of education is its explicit reliance on various modes of information communication technology, most obviously the Internet. The practice and design of online education is linked to an entire network of explicitly and primarily technological determinations (network protocols, routing infrastructures, computer interfaces, etc.), many of which (if not most) exist without concern or connection to the discipline, values, and concepts of education itself. While this feature of online education alone is not enough to support thinking of online education primarily through the lens of technological design, it does force at least an initial consideration of what technology is, and thusly, how we might connect it to educational practices.

As detailed in previous sections, at its most general, the practice of technology or interaction design is linked with a sense of having something to say, or putting forward some point of view about what is made in those practices. Looking again back to Aristotle’s *Nicomachean Ethics* (1998, bk. VI, 4), τέχνη is presented as a virtue concerned with “contriving and considering how something may come into being which is capable of either being or not being, and whose origin is in the maker and not in the thing made” (p. 141).
Here, the kind of knowledge found in τέχνη (as the root [techne] of the contemporary use of “technology”) is understood as related both to the produced object and the intended mode of the use of the object (Heidegger, 1997b). τέχνη is seen not just as an epistemic virtue connected to the making of the object, but is also linked to the function of the object once completed and put to use beyond the purview of the creator. In this, τέχνη is not focused on the conditions of the present moment, but instead on the possibilities offered and how those possibilities may continue to play out beyond the initial moment of creation (Heidegger, 1997b).

From this early definition, technological activity contains an implicit anticipatory orientation for the possibilities of the object made that extend beyond the object or the knowledge of how to make the object. For the design of online education specifically, this comes to expand the work of technology design beyond the combination of relevant technologies together in a particular way for the already-defined purpose of education. Instead, design is to be understood as working with and producing a relevant and intentional vision for what is possible. This understanding of technology design as extending beyond the establishment of a kind of mechanical function is reinforced by Susanne Bødker (1998) when she says that design “focuses on the parts of computer system development that are directed toward the creation of something new” (p. 109).

This kind of specificity given to our understanding of what technological practices are in relation to the development of computer systems in some ways obfuscates and calls attention to a more fundamental consideration of the role of technology in constituting the presence of thought. In a consideration which begins in his critique of Husserlian phenomenology (2011) and continues into work concerning the function of the trace (1997), Jacques Derrida clarifies a basic understanding of how to understand the relationship
between technology and the possibility for thought (C. Johnson, 2005; Shakespeare, 2013).

Navigating the divide between immanent and transcendental experience found in
phenomenology, Derrida (2011) asserts that in its reliance on the figure of the trace, the basic
sense of an internal voice of thinking is a technological matter, as inscription transcends the
bounds of the immanence of the individual subject in an autopoietic manner. That is, the
basic act of human consciousness and cognition become an issue of technological inscription.

This schema guides Derrida’s (1982a) development of his non-concept of *différance* which
serves as the locus of his assessment of the relationship of a technological *trace*, and which
allows for “the possibility of conceptuality, of a conceptual process and system in general”
(p. 11). Combining French renderings of “difference” and “differal,” *différance* focuses on
the interplay of presence and non-presence that makes the appearance of metaphysical
structures possible:

> On the one had, it indicates difference as distinction, inequality, or discernibility; on
> the other, it expresses the interposition of delay, the interval of a spacing and
temporalizing that puts off until “later” what is presently denied, the possible that is
> presently impossible. (Derrida, 1973, p. 278)

For Derrida (1982a), it is the play of *différance* that makes possible any semblance of an
ontological and pre-subjective grounding of consciousness:

> And we will see why that which lets itself be designated *différance* is neither simply
active nor simply passive, announcing or rather recalling something like the middle
voice, saying an operation that is not an operation, an operation that cannot be
conceived either as passion or as the action of a subject on an object, or on the basis
of the categories of agent or patient, neither on the basis of nor moving toward any of
these terms. For the middle voice, a certain non-transitivity, may be what philosophy,
at its outset, distributed into an active and a passive voice, thereby constituting itself by means of this repression. (p. 9)

While a radical assertion, Derrida’s claim for a leveling of what is property of the human subject and what of technology, and his inability to oppose an anthropocentric concept of the human and a non-anthropocentric concept (Roberts, 2005) lays the groundwork and provides philosophical support for the subsumption of the whole of human activity to some broadly-writ mode of technological activity or vice versa, each under the banner of *différance*. This function of *différance* appears as an open system (C. Johnson, 1993) out of which the figures of humanity, technology, and even education arise, without ever becoming wholly distinct (Roberts, 2005). Each term, the technological and the human, is understood to be dependent on and contained within the other. Any attempt toward analytic distinction is impossible.

For the purposes of understanding the relation of a technological practice to the educational aims of online education, it is enough that such intertwined and paradoxical foundations of human beings and technology can be, for the moment, only hastily sketched out and the implications left to rest. What is central is that conceptualizations of τέχνη and *différance* demarcate the open ended span of the system of general technological practice.

While any analytic distinction between the basic constitution of the human subject and technological practice becomes difficult (if not impossible), there remains an at large surface distinction between what is considered technological and what is understood as the educational purposes at work in the design of online education. Here, the central problematic of the technological instantiation of certain values for education confronts the open and anticipatory nature of this general technological practice. In looking to establish a framing for the development of educational concepts within a blossoming of online education, how
should the values and categorical understandings of the discipline of education be incorporated into the critical practice of design? By shifting the primary consideration of online education design toward a wholly technological design-centered discourse (specifically one founded in a radical form as a general technological practice), it is possible to set the problems and questions faced by online education under a single rubric or paradigmatic set of terms that is able to account both for the medium of education, as well as the concerns surrounding the instantiation of values in design.

**Categories and Values in Design**

Already within the domain of technology and interaction design there is a well-established and diverse body of work focusing on the shaping of values through the work of design. Founded on the basic conception of user-centered design (to promote the needs of users over the purely technological possibilities of a system), a number of approaches such as participatory design (Schuler & Namioka, 1993), meta-design (Fischer et al., 2004), and value sensitive design (Friedman et al., 2008) have been developed. For the most part, these approaches seek to incorporate the particular insight of users and those working within specific domains (such as, for instance, educators and students) into the work of design and to guard against problems that can develop when human values and needs are covered over by technological solutions.

Such an assortment of techniques and recommendations for the management and inclusion of certain sets of values in design, however, does not automatically guarantee that it is possible to attend to the design of online education primarily through a technological rather than a domain specific discourse. Even starting from some of the earliest critical work in the study of interaction design, the question of the possibility of finding some ontologically-
neutral framework for understanding the relationship between human modes of understanding and computing remained a point of debate.

As has already been discussed, historically speaking, in looking to match human need with technological possibility, there came to be widespread agreement that the ontological perspective of computing (one which was rigid, pre-determined, etc.) did not match up to the ontological perspective of human beings (which is considered as flexible, open to change, etc.) (Ackerman, 2000; Dreyfus, 1979; Winograd & Flores, 1986). While there was some suggestion that these ontological differences could be subsumed by a recourse to categories of communicative action (as developed from a perspective based on Austin's (1975) speech act theory) (Flores et al., 1988), this notion was tamped down by the complaint that any attempt toward the establishment of categories to describe human activity was, in its very constitution, a limiting and mechanical move (Suchman, 1994). The carving out of specific categories for others to use was seen as a mode of disciplinary control over those who may come to be subject to the use of such categories. Here, Gadamer's conception of the situation, as detailed earlier in relation to the question of design, is equally applicable to the question of values as well. Each move toward the establishment of values is as contextually-founded as the specific conditions of use.

The question of the disciplinary mandate of the category is raised again, in a different light in discussion surrounding the continuing development of value sensitive design (Borning & Muller, 2012; Dantec et al., 2009; Friedman et al., 2008). There, against the proposal that there should be basic sets of values that designers should be cognizant of in the process of design (such as human welfare, ownership and property, privacy, freedom from bias, etc. (Friedman et al., 2008)), the question of whether such a listing off of categories of values is enough to really respect the needs and desires of users has been raised (Dantec et
That is, are values, amorphous and far reaching as they are, able to be reduced to a checklist or should they be approached in some more broadly-stated humanistic fashion?

Each of these critiques of the possibility for a certain mode of formalized consideration of values or conceptual categories in the work of design points in the direction of a Derridean conception of the dissemination of meaning as established in his thinking of *différance*. For Derrida, the present stability of any concept, in its repeatability, relies on a network of other terms, to which any meaning is deferred. Just as with the inability to isolate the concept of human being from its supposed technological opposite, the establishment of any category or value is fraught with implications beyond (and sometimes contradictory) to its intention. So, just as values are understood as concepts that are lived and emergent rather than in tabulated form, this general sense of dissemination binds separate meaningful constructions of value-categories together in such a way that they are inseparably determined by the larger field in which they act. One meaning is always linked to another and the conditions of its explication.

In this figure of the deferral of meaning, as with the anticipatory nature of the coming newness in design, it is possible to recognize Derrida's (2006) notion of a non-religious messianic “to come.” Just as technology and design are each concerned with the implications of what is not yet present, our understandings of what is necessary when considering categories and values for the future of online education is likewise not yet present and still to come. The conceptualization of values and categories of online education are radically open things not to be decided before hand, but only in the work of design itself. For Derrida, this sense of the “to come” is not relegated to a simple novelty of innovation, but speaks to a kind of ontological novelty which is founded based on a more broadly-set consideration of the occurrence of events rather than of the experience of technological novelty. Such question of
the sometimes convoluted path of technological novelty (as discussed by David Edgerton (2007), for instance), are distinct from both Derrida's explication of the “to come” and the kind of situated newness in design considered here. As will be discussed further on, whether an innovation in online education is presaged by some previous tradition or not, or if an innovation serves to simply replicate an existing ideological structure, there still remains an anticipatory and not-yet-present aspect to the work of design.

Building on the basic connection between human thinking and technology, this radical recasting of the determination of values in design begins to open up a consideration of practical measures involved in the establishment and development of values in a specific area such as online education. Already at this provisional point, given the open and praxis-based nature of the instantiation of values, the figure of the discipline of interaction design, with its already-considered critical approach to questions of the instantiation of values, seems well-established to guide online education as it moves the paradigm forward. By pointing to critical aspects of the function and possibility of meanings which are left yet to come, the work of online education design is given an explicit framing for understanding the development of new values and concepts. All this under the rubric of technological thinking. Operating under this paradigm of general technological practice, it is now possible to return to the question of the event of design as developed earlier in this chapter.

**Ethics and Events of Design**

In its radicalized form, a technological interaction design steps away from the safety of the terrain of already-established and present concepts and instantiates that which, for all intents and purposes, can only be thought of as new. Recalling Bødker’s (1998) definition, the result of design is always and necessarily founded as some kind of eventful newness that is disentangled from any structural genesis that may be found as antecedent. In laying this out
in ontological terms and (as discussed above) avoiding a historical reading of novelty, it is this kind of unstructured genesis that Derrida’s conception of *différance* makes clear.

What subsuming the question of educational values to a question of technical practice does, under this Derridean schema, is to make the forward looking and anticipatory practice of designing online education one which is centered on a consideration of ethics. As discussed earlier, for Derrida (1995), the question of the ethical decision is one which is founded on this exact sense of anticipation and openness. The truly ethical decision is that for which the response and the consequences of such a response can never be known or calculated in advance. In the elevation of the central quality of an unknown newness over mechanical assemblage of known parts for a known function, the work of technical design turns and becomes more innately human than any discourse founded in a disciplined educational practice.

This view of ethics—of the need for a radical moment of judgment—carries with it a shadow of an Aristotelian version of virtue ethics, and the kind of skillful, non-categorical judgment that is to be fostered under such a system. Particularly in the figure of *phronesis* (practical wisdom), the mode of judgment is such that it relies explicitly on this kind of undecidable setting. Like hermeneutic interpretation (Gadamer, 2004), *phronesis* relies on the translation of past experience to present (and unique) settings. The figure of technological practice, as that which is fundamentally linked to the constitution of the human, rests on this mode of undecidability with the moment of design decision coming as a break between the undecidable future and (on the basis of the need for its interpretation) the undecidable past. Considered in this hermeneutic light, set at the opposite pole from the opening of the “to come” in the event of design is the reliance on such a moment of decision on a background of experience and tradition that guides such decision.
In this, the result of understanding the development of concepts and values surrounding online education wholly within a technological frame binds the question of design to traditional concepts such as ethics and values, while, at the same time, asserting the weakness of any such concepts, as they too are subject to deconstruction and critical re-evaluation in the opening of the “to come” in design. This sense of conceptual weakness sheds a particular light on the travails of information science as a whole. Given the link between human activity and technology (and particularly as it is seen in the link between information and its technological expression), the conceptual weakening seen in this reading of the work of design is addressed more broadly to the work of information science. This conceptual weakening highlights the reflexive function of information science, illustrating that it must be open to the constant reformation of the possibilities of information, technology, and values and concepts that are expressed through them.

**Recommendations**

While it goes somewhat against the spirit proposed by such a discussion of the necessity for a continual reevaluation of concepts (even those as fundamental as technology or education), several concrete recommendations for guiding this understanding of design are nevertheless possible. The four recommendations that follow are offered as two sets of countervailing pairs with each recommendation offering a nuanced contradiction to its partner. In this, they represent the kind of apophantic positioning contained in any anti-humanist stance such as the type that will be continued to be developed in the following chapters. These recommendations cover over the actual function of design, a fact which is pointed to in their paired countervailing construction. As Gadamer (2004) puts it, the question is “not what we do or what we would to do, but what happens to us over and above our wanting and doing” (p. xxvi). As in the consideration of the possible determination of
specific values in education, these recommendations serve to highlight the contingency of making design decisions within an emerging domain such as MOOCs.

**Recommendations for Understanding**

**Tradition as guide, not law.** In looking to understand the concepts, values, and ideologies surrounding and shaping online education, it is necessary to look to the established traditions of education in order to guide the evolution of concepts and values. Understanding emergent forms of online education necessarily relies on established and sometimes even stale considerations of education. For MOOCs, these traditions range from considerations of early online education (Harasim, 2000) to understanding the correspondence courses which set the stage for what distance education could be (Larreamendy-Joerns & Leinhardt, 2006). Such traditions, of course, are neither perfectly knowable nor are they without contradiction to one another. As such, while the guiding theme of hermeneutics recommends a firm attention to the traditions of interpretation surrounding any object of culture, such tradition cannot be held to in lock-step manner. Instead, it is important to approach the question of tradition with a sense of *phronetic* judgment. This kind of practical wisdom built on a wealth of experience is the model on which it is possible to understand our hermeneutic relationship to tradition. The work of the design of online education is such that the designer must be guided by the previous traditions and the concepts and forms that they bring to light, but must also be judicious in their re-translation of this tradition into new technological forms instantiating new values.

**The undecidability of the concept.** As is central to Derrida’s mode of epistemic interpretation, it must be remembered that our ability to fix any particular conceptual (or traditional) meaning in place is limited, with the definition of a concept being spread out over a network of historical and conceptual linkages. When considering the development of the
meaning of education across a span of time or various interpreting populations, there remains
the practical possibility for an epistemological break in which the terms, values, and
categories used in online education at one moment are incommensurable with another
moment of their interpretation. It is possible that how we understand online education today
will be at odds with the way in which we consider it tomorrow. Such a shift is already readily
visible in the development of MOOCs as the terms of what is considered successful in
education are subject to rapid shifts and radical re-interpretation (Koller, Ng, Do, & Chen,
2013). Whatever the motivation for such re-interpretation, the technological developments
that herald them accord to the undecidability explicated in différance.

Recommendations for Action

The decisive nature of ethical action. In light of the need for individual action
within an ever-developing historical field, there is, as established in slightly different forms
by both Derrida (1995) and Alain Badiou (Badiou, 2001), a call for a radical form of eventful
ethical decision that can be applied to the work of technology and interaction design. As
discussed, this kind of ethical action takes the form of a true decision. Given the kind of
undecidability present in any concept, the work of instantiating particular values in the design
of new systems for online education immediately takes on this kind of decisive character.
There is a need to consider the way in which, as a creative activity, the design of online
education functions as an event that, in the undecidability of the terms of its
conceptualization, should be considered as being ethically conditioned, as there is no
predetermined outcome the the chain of the deferral of meaning. For online education, this
points to the value of a cyclical and reflexive mode of design (Clow, 2012) in which the need
for an initial decisive act of design is necessary to begin a robust and reflective approach to
the continued iteration of the work of education design. In this, as in the recommendations
for understanding above, an appeal to tradition for the direction of the initial work of design is complicated by both the instability of any conceptualization of tradition and the following translation and iteration in design.

**The field that contains this action.** Outside of any undecidability of understanding, online education still also feels the pull of tradition and exists within a historical field of action. This gets to the heart of the quote from Gadamer above: that even beyond our ability to act, there remains some course to development that we have no hand in. As such, for the design of online education (and this is the grand lesson demonstrated by Social Informatics (Sawyer & Eschenfelder, 2005)), we are not, as designers and educators, able to design completely away social problems or to wholly reconfigure the social forms so as to be most hospitable to our (technological) hopes for online education. Online education takes place within a wide field of historical action which is itself both overdetermined and undecided. As they develop, the artifacts of MOOCs themselves come to play an active role in the determination of this sense of historical effect (Ponti, 2014), adding complexity to this field which delineates the possibilities for any ethical action.

**Discussion**

More than offering a formula for direct future action, these recommendations are aimed toward a kind of critical conceptual development. They point to the more broadly writ central contribution of this chapter: that the work of design is always within a particular historical and contextual setting and as such, by definition, functions in a radically open fashion. It teeters between the needs of technology and use. The link between the work of design and the values that it produces is founded at this fundamental locus of contingency and openness. Just as the values, meanings, and functions instantiated in the work of design are best understood on a case by case basis given the particular setting of any design
problem, so too is the work of design contingent. The technical and social novelty of MOOCs makes this evident.

As has been sketched out, an ontology design of online education can be conceived of as an eventful interaction of intention and technological possibility. There are both moral aims in education, as well as technological concerns that, more in line with Simon’s more engineering-centric picture of design, serve to provide a distinct and portable formulation of how to achieve some goal. The technological tools that make such things as long distance and distributed communication possible are a kind of accomplishment that can be considered in a way wholly-distinct from educational intents.

This independence comes to an end with the event of design in which the ideals of education are expressed in technological terms, or, conversely, when technological tools are given purpose in an educational context. While an initially hermeneutic rendering of this points to the revelation of a unified horizon which supports the two distinct positions, the event of design introduces such radical alterity that it must be confronted in a mode of hospitality. That is, from the perspective of design work, the event of design does not reveal anything about the world, rather, it asks of how this new design may be welcomed into the world. This can be seen in the case of MOOCs: rather than providing insight into the existing conditions of education, their design has challenged present understandings of what education can be going forward (Russell et al., 2013).

In the ontology of online education design, there is not simply a gap between technological capabilities and the needs of users. Instead, both the aims of education and of technology are understood to be developing, with the event of design bringing these two distinct epistemological framings together into a coherent formation. For designers, this places their work within a specifically historical moment, one which not only provides the
ethos of education and the technological tools, but also the surrounding situation into which their work will be welcomed.

While empirical insight and the development of tools to improve online learning provide valuable contributions, for the work of interaction design itself even these kind of scientifically-derived best practices are still beholden to a more foundational and situated interpretive mechanism. Indeed, it is precisely because of the situated nature of the work of design that user-centered and value sensitive design have been developed. For online education, the specific domain level insight of educators plays an important role, one that is able to be accounted for in the design process, but not the other way around. Educational discourses may be contained within discussions of technology, but to structure it the other way around seems impossible. Technological discussions of the politics of artifacts, the act of technological making, or of how values and categories can be determined through processes of design are able to go on without recourse to the specific discourse of online education, but the reverse of the situation can not be possible. This is not to in any way give ontological privilege to the technologies involved in online education over the educational impulses themselves (a move which would contrast sharply with the Derridean framing given here). Rather, it is simply to set out a useful and expedient framing of the space shared by technology and education. By establishing the discussion surrounding online education as one of technology design and founded on the already existent critical considerations of values and categories in the work of design (especially as radically reconsidered here), those educational discourses voiced by teachers and administrators are given the kind of open space that they need in order to make the most impactful contribution possible.

At bottom, this chapter is meant to serve the kind of edifying and therapeutic function described by Richard Rorty (1979): It is not that we will find any final answer for the way in
which new concepts in education develop, but that by approaching questions in a philosophical way, we condition ourselves for confronting them. Such discussions steel ourselves for further action. In understanding design in a rigorous way, given the various and heterogeneous nature of the open-ended and generative aims of the work of design, there is little more that can be hoped for beyond a conceptual grounding in an ethical and eventful field of action.

In the same way, the present discussion of the values and purposes of online education and how these issues should be approached and managed seeks to provide a similar sense of therapeutic benefit. By framing the anxieties and possibilities surrounding online education as, above all, technological problems, the hope is that this formulation offers a therapeutic framework that can be turned to as educators, designers, policy makers, and researchers seek to continue the ever-changing project of redefining education for our era. MOOCs, in particular, seem to engage these anxieties in both broadly social (Byerly, 2012) and technological (Russell et al., 2013) ways. The possibilities for MOOCs, like the work of design that makes them possible, remain open.
Chapter 4

The Conditions of Peak Empiricism in Big Data and Interaction Design

Empirical research into user requirements and behavior has been a key element in the work of information and interaction design since the founding of both programs of human-computer interaction and user-centered design research (Carroll, 1997). The rise of mechanisms able to capture large amounts of empirical data regarding user behavior opens the door to new possibilities for research and design (Barakova et al., 2013). User trace data (Østerlund et al., 2014), physiological data (Van Den Broek, 2013), and other sensor data (Alonso et al., 2013; Terzis et al., 2013) all contribute to the generation of large sets of user data. The potential impact of such large sets of data in design can perhaps be best seen in the discourses surrounding the rise of so-called “big data.” While gaining traction in many areas (Callebaut, 2012; Ekbia et al., 2014; Mayer-Schönberger & Cukier, 2013), the ultimate potential for the uses of big data in understanding users remains unproven (boyd & Crawford, 2012; Marshall, 2012).

Characterized by the volume, variety, and velocity of the data able to be collected (Laney, 2001), “big data” relies on advanced networks of information capture and management. In its size and the dynamic characteristics that it presents (Gobble, 2013), it is reliant on computational modes of analysis (boyd & Crawford, 2012; Manovich, 2012) and allows for the management of previously unavailable levels of complexity (Callebaut, 2012; Mayer-Schönberger & Cukier, 2013). As pointed out by Ekbia et al (2014), this complexity often exceeds traditional accounts of human cognitive ability (Kraska, 2013; Weinberger, 2012) and approaches being simply a form of noise (Wong et al., 2012).

Laying out a series of cross-cutting “dilemmas” posed by the advent of big data,
Ekbia et al. (2014) highlight the epistemic and methodological challenges presented by big data across a number of disciplines. In doing so, they focus on a specifically-empirical rendering of epistemology in their discussion of the tension that exists in big data between remaining faithful to appearance or to the phenomena itself. As will be seen, here, approaching the question of the relation between empiricism and big data, I will set this question within a wider field of epistemic consideration, encountering empiricism as one epistemic theory among others and as such not taking the question of subjective representation in epistemology for granted. As will be developed, in opening this wider constellation, the central epistemic theme of representation discussed by Ekbia et al. will be given an alternate rendering that hopefully adds nuance to their review and analysis. While they explicitly note that epistemic approaches attempting to level the distinction between appearance and the phenomena have found little space in the methods of big data, I hope to show how such an account is necessary, if not inevitable.

In limiting my attention here to the particular epistemic challenges faced in interaction design, I look to provide a discussion of one example of the epistemic effect seen in the rise of big data. The concepts and framings developed here have the possibility of being applied to any number of areas implicated by big data. The applicability of such concepts is particularly seen in areas that are easily encountered as modes of post-positivist research, such as the social sciences (Bernstein, 1983). Like interaction design, in post-positive understandings of science, the influence of the particularly situated perspective and aims of the investigator are readily evident. As will be developed here, big data comes to challenge this perspective in a heretofore unseen manner. In looking at interaction design, I provide explication of one specific cross section of the wider epistemic issues raised by Ekbia et al. While focusing here on interaction design, it should be clear that the formulation presented here may be able to be rendered more generally in the future.
In the case of interaction design, the increase in available empirical data about users and their behavior alters the character of design and the relationship that data has with the goals and intentions of the work of interaction design. Given the opportunities afforded by the developing agenda for large-scale interaction design (Cramer et al., 2010; Cramer, Rost, Bentley, & Shamma, 2011), it is worthwhile to consider the foundational impact that such reserves of data might have on the work of interaction design and to begin to re-think interaction design’s relationship to empirical data.

I am proposing an alternate reading of empirically-influenced design in response to the conditions set forward by the possibilities emphasized in discourses of big data. What is laid out in this chapter is a consideration of how the sheer “bigness” of the empirical data that big data claims to offer alters our understanding of design work. Such a stance seeks to continue to build out an understanding of data, information, use, and design as being historically and particularly situated (Day, 2001; Suchman, 2006). It stands in contrast, though not in opposition, to a view of the empirical uses of data in design that see data as a source of inspiration and representative insight into user behavior (Iqbal, Sturm, Kulyk, Wang, & Terken, 2005; Korn & Bødker, 2012; Kulkarni et al., 2013). My intention is to chart the developing terrain that comes with the increase in scale and to not approach either big data or empiricism from an explicitly critical perspective.

In this chapter, I point to the future possibility of something that I term “peak empiricism”: that the scale of big data establishes empirical conditions such that, for considerations of design work, the actual empirical value of any data plateaus. As will be detailed, as data becomes “big,” the metaphysical structures established in support of empiricism begin to collapse. The volume, velocity, and variety of the data overwhelm the necessary conditions of empiricism, with peak empiricism pointing to a moment of conceptual exhaustion of the possibilities of empiricism. In this, I look toward how designers...
come to “think with” big data in the work of empirically-based design and consider the agentive matrices that come to exert their influence over the work of design in such an epistemic schema. This presents a challenge to designers and researchers to consider how their individual agentive actions impact design outcomes and how they give away such agency to the insight given by big data.

The structure of the chapter is as follows and is largely dictated by the philosophical argument presented. The first section following this introduction lays out a general introduction and discussion of the concept of peak empiricism. Following the introduction of the concept, the argument of the chapter begins in earnest with the establishment of our understandings of both the question of representation in science and the mode of reflective design practice discussed. Building on this explication and placing it in the context of big data, I develop the argument that gives shape to the remainder of the chapter. It follows from the reflexive conditions of design and empiricism through a reading of the “textured” nature of the situation of design. From there, a consideration of the particular mode of “thinking” found in the work of design points toward a reconsideration of the non-agentive character of this thinking. The chapter closes with a consideration of the conceptual implications for the work of interaction design in an era of big data.

**Peak Empiricism**

As will be developed in more detail throughout this chapter, peak empiricism is a concept that refers to the projected moment at which the sheer scale of large sets of empirical data come to overwhelm the theoretical conditions that make empiricism possible. In developing this concept, I point to a fundamental consideration of empiricism understood as an epistemic approach which places primary importance on knowledge derived from the senses over that which may be achieved through intuition (Hume, 2011; Locke, 1996). While the exact role of empiricism in science remains a point of constant contention (Barad, 2007;
Bernstein, 1983; Callebaut, 2012; Kuhn, 1996; Popper, 2005), what is vital for understanding peak empiricism is that at its foundation empiricism relies on separating a knowing and sensing subject from the object of investigation. Peak empiricism describes the theoretical moment in which the subjective position of the observer is lost against an outsized engagement with a background of rich empirical data. If Michel Foucault (1994) proffered a theoretical moment of the invention of the subject, then this would proffer the opposite—not in a symmetrical undoing toward any sort of originary position, but an undoing of the subject in the form of a further development of human discourses. With big data, empiricism (as an epistemic strategy) loses its necessary conditions for operation—a loss which forces a re-evaluation of the work of science. In its growth toward this peak, empiricism remains an invaluable approach for the production of knowledge. However, as will be described, in reaching this peak the terms of science and the products of scientific investigation are altered.

At present, advances in the collection and analysis of empirical data seem to coincide with similar advances in empirical insight. Putting this in terms of interaction design: with more empirical data concerning use, designers are able gain better empirical insight into use and thus are able to design better applications. This increase in the benefit derived from an increased scale of empirical data peaks and levels off as the scale of data utilized begins to destabilize the subject-object relationship on which empiricism relies. This is not to say that there can be no additional benefit to further increases in the collection and use of empirical data in design, just that any such benefit would not be able to be understood as coming from empirical insight. Instead, any additional insight after the arrival of such an empirical peak would require a different theoretical understanding.

Set against a background of the availability of large sets of data, there are two main complementary phenomena that lead the way toward the conditions of peak empiricism in design. First is the reflexive incorporation of data about users and their behavior into the
function of applications. Simple examples of this would be social media or any mode of automated content curation (ranging from search results to online lists of most-read articles). In both cases, the value proposition of an application is derived from the ability to leverage information about users and their behavior as part of the function of the application. Such a reliance on user data points to a double role for data in design; the data serves to provide insight to designers about users as well as functioning as part of the materials of design. As the data both functions as empirical evidence concerning user behavior and is also intimately connected to the use of an application, it becomes difficult to identify the proper “object” of empirical investigation. In that the conditions of use being investigated are at one moment both indicative of the object of design and are the object of design themselves, the proper object of the subject-object relation of empiricism begins to weaken.

Second, beyond the reflexive difficulties that such an autopoietic setting presents, the sheer scale of the data begins to define the situational conditions of both design and use. In large part due to the pervasive reach of the Internet, design (as both a subjective activity and object) is increasingly intertwined with social structures (Dubberly, 2008; Norman, 2010). In this, the work of design and the empirical data on which it relies each become conditioned and understood in reference to the larger social setting. This, however, is not a one-way movement, with computerization and the work of design also conditioning social forms (Kling & Iacono, 1988). With an increase in the scale of empirical data and the pervasive view of use that it is able to provide, there is a subjective difficulty in disentangling a subject (conditioned by their experiences of big data) and an object (represented in that same data).

Against this weakened theoretical foundation of empiricism, design reveals itself to be less the providence of a pointed empiricism than it is the providence of a mode of a messier and more engaged mode of everyday experience. As the volume of empirical data increases beyond a certain level (loosely defined by the limits of rational human sense-
making (Kraska, 2013; Weinberger, 2012), the data no longer provides pointed and specific insight (as in the case of the empirical validation of scientific theory). Instead, it comes to give a generalized sense of the larger situation. That is, the specific empirical character of data which might tell us about the relationship between subject and object is overwhelmed by its own volume (and dynamic velocity and variety) and instead comes to provide the general conditions for the work of design. Paradoxically, what this means is that by providing such an expansive empirical setting for the work of interaction design, big data reduces the empiricism of design work. It weakens any conception of a narrow subject-object relation in favor of a more embedded approach to the relationship between a designer, their work, and any data involved. Instead of just giving insight into the specific usefulness of some feature of an application, big data provides a view into the entire system of use. This perspective is one that includes not only insight into the user and the application, but also a view into the larger social system in which the designer may also be embedded. Such a moment would be considered the peak of the possibilities of big data empirical methods.

This is not to present a critique of either big data or of quantitative or computational methods in general. Neither is this conception of peak empiricism a validation of such methods. While certain strains of epistemic development have been evident in HCI design for some time (Bardzell, 2010; Bødker, 2006; Harrison et al., 2011), the conditions put forward by big data ask for a different kind of consideration than those which are motivated by cultural or situational determinations. Similarly, where Ekbia et al. (2014) present an epistemic tension between appearance and phenomena brought on by big data, peak empiricism avoids such binaries by way of a radical consideration of the founding of empiricism as an epistemic technique. In offering a careful look at the theoretical implications that this changed state of affairs has for empiricism and design, an alternate reading of both data and design emerges. The balance of this chapter will be devoted to
laying out the conceptual terrain that engenders such a conception of peak empiricism and the implications for such a shift. This starts with a discussion of representation and scientific theory as understood in relation to the specific mode of reflective design considered.

**Realism and Theory in Design**

Advocates of big data approaches (Anderson, 2008) tend to discount the importance of scientific theory in guiding empirical work in favor of data-intensive predictive modeling (Callebaut, 2012). Able to function without the need for ideologically-based theoretical rumination, the data, as the saying goes, would be able to speak for itself.

Well before the rise of big data, however, Ian Hacking (1982) put forward a proposition that a belief in scientific realism can be supported by the fact that we are able to do things as the result of our scientific knowledge: We don't just have an epistemic theory about electrons; we are really able to enact a change in our environment with those things we call electrons. It is this effective ability that allows us (the human interlocutor) to talk about something as immediately invisible as electrons in a such way that we assume their realness.

Hacking's sense of realism proves to be extremely useful for discussing design and is, in part, very similar to the epoch-making definition of design given by Herbert Simon (1969). For Simon, design is understood as any course “of action aimed at changing existing situations into preferred ones” (p. 55). This definition matches Francis Bacon’s definition of experimentation that is used to motivate Hacking's realism: “when by art and the hand of man she is forced out of her natural state, and squeezed and moulded” (as quoted in Hacking (1982, p. 75)). Design, like Hacking’s perspective on scientific truth, is focused on what really can be done.

For interaction design, the proof of a realistic a-theoretical perspective would come in its ability to achieve workable results using data alone to guide the work of design. If we are
able to design, build, and validate successful systems without the use of theory, then that is
demonstration that theory is unnecessary. However, as numerous (and better informed)
discussants have pointed out (Callebaut, 2012; Shum, 2013), even in the presence of an
overwhelming amount of data which appears to offer deep insight into a phenomena, there
exists an entire theoretical scaffolding that supports any analysis. Even if one were to
discard theory per-se, there nevertheless exists some tacit theoretical presuppositions in any
mode of research. Simply by asserting that the measurement of the duration of a task or that
user sentiment plays a role in system effectiveness a theoretical commitment to some
epistemic and ontological position is still being made. Such a commitment comes at the level
of an assertion of the independence of the subject and object, the validity of sense data over
intuition, or even basic questions of realism and relativism.

Karen Barad (2007) specifically critiques Hacking's attempts to avoid the kind of
representational thinking associated with theoretical science as not going far enough:

- despite Hacking's best intentions to leave representationalist beliefs behind [as those
  that might constitute a theoretical position], his entire realism takes on board one of
  representationalism's fundamental metaphysical assumptions: the view that the world
  is composed of individual entities with separately determinate properties. (p. 55)

Focusing on how any realistic approach to the world is constituted by a combined
understanding of ontology and epistemology, Barad (2007) claims that “different intra-
actions produce different phenomena” (p. 58) and that “one can't simply bracket (or ignore)
certain issues without taking responsibility and being accountable for the constitutive effects
of these exclusions” (p. 58). In looking at one aspect of a design over another, or in
establishing one “preferred” situation over another, a constitutive action is taking place.

In this, we can see how it might be impossible to disentangle the agentive intention
behind the work of design from the empirical assessment of the conditions of use or the
assessment criteria for the design itself. After all, the perspective from which the success or failure of a design is judged is developed alongside the design itself. One is completely dependent on the other, as has been demonstrated by the co-evolution of problem and solution spaces in design (Dorst & Cross, 2001). Design is a generative activity that does not rely on previously decided types, but instead introduces new types. This generative work requires a reflective approach and a reconsideration of the new territory opened up (Schön, 1992).

Such co-evolution of problem and solution spaces provides design work a certain air of contingency, even when a specific design problem is under consideration (Cross, 1997; Dorst & Cross, 2001). As has been detailed in previous chapters, this picture of contingency in design is heightened by the integration of the concerns of specific designs into a wider field of social action (Norman, 2010). In this, contingent social practices are determined by related practices and so on. When focusing specifically on empirically-informed design, the reach of this situational contingency is expanded to include whatever particular determinations (social, ethical, or value-driven) have been imputed into the mechanism of data collection.

Whatever network of values is involved, the reflective work of interaction design is dependent on having an empirical understanding of the conditions of use. Design work relies on being able to understand and reflect on the effect that a designer’s work may have on such conditions. In the necessity for a material involvement with the object of design (as material for design), it is not enough for a designer to simply intuit either the form or validity of any design. It is only through empirical support that she or he is able to found their work as design. This empiricism can come in the form of user research done in advance or in the form of post hoc analysis, in either formal or informal ways. For both, there is a concern for gaining an accurate and realistic understanding of users and their situation, with such
empirical reckoning providing a basis for the condition and legitimization of design decisions. Based on this understanding of the work of design, I will now turn to a consideration of the impact of big data.

The Situation of Big Data in Design

From the position of a reflexive view of empiricism and design developed in the previous section, it is possible to start to consider the presumption that representations in empiricism might “serve a mediating function between independently existing entities” (Barad, 2007, p. 47). Just as Barad (2007) describes physicist Niels Bohr’s argument that scientific practices must therefore be understood as interactions among component parts of nature and that our ability to understand the world hinges on our taking account of the fact that our knowledge-making practices are social-material enactments that contribute to, and are a part of, the phenomena we describe (p. 26), so too should we understand the notion of big data as being co-present with the phenomena that it describes. It is not just that in designing applications we have a tremendous amount of user data to work with, but rather, it is that users and designers are both co-present with each other and with any data that is in play. In large part, such a consideration continues an argument developed by Ronald Day (2001) in his critique of the conduit metaphor for understanding information: Information is not seamlessly passed from subject to subject. The selective nature of its conveyance and the material and organizational work that goes into the construction of such a conveyance provides (and is provided by) an ideological scaffolding of power-relations and values that co-exist with any information that is passed along. Data, the object of design, and the work of design all exist together. It is their interaction that forms the totalized phenomena of design and use. The data of big data is as situational as the setting of use and the work of design.

In this entangled view of data, design, and use, the stable relations between subject
and object as the necessary foundation of empirical evaluation become weakened, just as positivist conceptions of the situation of design are weakened in the study of the conditions of use in interactive systems (Suchman, 2006). This weakening of subjective relations in the work of design is particularly seen in the overlapping role of data as both source of empirical insight and material for design as described earlier. The effect of this weakening of the metaphysical distinction of the subject and object is exacerbated in the case of big data by the numerous dynamic relations that are formed in such a large-scale collection of data.

As laid out in Jacques Derrida’s (1981) concept of dissemination, meanings depend on other meanings, and, applying this reasoning to large sets of data, insights derived from the data can also be seen to “radiate backwards” (p. 355). Considered at a fundamental level, this kind of movement “is defined (thought) by the operation and is at the same time defining (thinking) as far as the rules and effects of the operation are concerned” (p. 355). As will be detailed, this provides an active sense to the role that the data plays in design. This characterization of data and the way that it is actively thought with in the process of design is reinforced by the continually renewing “velocity” of big data. As it becomes synonymous with understanding use, function, and design, empirical data—as in Derrida’s dissemination—always points elsewhere.

The Texture and Scope of the Experience of Design

Highlighting the network of meanings that develops within and without big data in design, it is not only the epistemological character of data that comes under question, but also the ontological role that it has. Looking to understand the “ontological dimension of scientific practice” (p. 42), Barad (2007) asks “[d]oes the full ‘texture’ of nature get through, or is it partially obliterated or distorted in the process?” (p. 42). To an extent, this question mirrors that set up by Ekbia et al. (2014) in their discussion of Bas van Fraassen’s (2008) Appearance-from-Reality criterion in relation to the scientific image presented by big data.
The distinction for us, however, is that the question is not one that starts with a competition between appearance and reality, but starts instead with the proposition (developed in different ways by Barad (2007) and Day (2001)) of a type of enacted (or phenomenological) unity of the epistemic and ontological work of science. Such questioning not only builds on the critique of a reductionist view described in the previous section, but also addresses the kind of world-making function that data comes to have in support of the work of design. As co-present with the work of design, how is big data experienced?

Where other modes of empiricism used to inform the work of design extract particular nuggets of knowledge based upon a selective criteria (as in the case of usability testing or the development of specific design requirements), big data has the possibility of opening up a different mode of empirical reflection. In its potential to offer a broad based, dynamic and multi-level view of a phenomena (Callebaut, 2012), big data presents a particular texture to the understanding of use.

Instead of having the chance to understand use in either just a constrained, targeted, and laboratory fashion or in a local and ethnographic manner, big data offers a different perspective. This is not one that is just a third way between quantitative and qualitative approaches, but one that presents a different configuration entirely. Exploring the online behavior of users in a social media platform, for example, is a different proposition with big data. A designer does not come to understand just one facet of use or just the use of a single user, but sees the dynamic and varied use across the entire ecosystem of use. The variety and dynamic connections that are illustrated across a wide network provide a different texture to the experience of data. In that these networks of relation connect with and play an intimate role both in everyday life (as in the case of a social network for users, or in providing the materials with which designers engage), such texture comes across not just as empirical representation, but as a phenomena themselves.
This contrast between the experiential textures offered by big data and traditional empiricist methods is best understood in Hans-Georg Gadamer's (2004) subtle German-language distinction between two types of experience, *Erlebnis* and *Erfahrung* (Weinsheimer & Marshall, 2004). For Gadamer, *Erlebnis* refers to the kinds of pointed experience that we are able to isolate in some fashion. This is the kind of experience that people consciously have of a vacation, a movie, or any other memorable occurrence. *Erfahrung*, on the other hand, provides a more overarching sense of experience, as that which we undergo, as we experience the cultural traditions that we grow up with. In this way, *Erfahrung* provides the background against which other experiences are set.

This distinction highlights one of the effects that big data has. Traditional modes of empiricism supported by small sets of data provide a pointed (and often theoretically-directed) view of a phenomena which can be understood in the manner given in *Erlebnis*. That is, designers and researchers are able to have a particular experience of the data and what it tells them about the phenomena in question. With big data, however, the empirical story provided is not such that it necessarily gives particular and immediate insight. Instead, the pervasive size, heterogeneity, and dynamism of the data gives an overarching sense of experience more along the lines of *Erfahrung*, and plays a constitutive role in the experience of a designer. That big data is able to provide depth and can be investigated along a dynamic range of levels give it this constitutive character.

By providing a robust account of either a small scale phenomena (at a great level of detail) or a large scale phenomena (with an expansive view), the kind of (mainly) quantitative approach that is characterized in big data begins to turn away from its positivist roots and offer a different mode of experience. This follows a version of Friedrich Kittler's differentiation of those technologies that create a mere representation of a phenomena (writing, for example) versus those that provide an imprinted record of nature (audio
recording, photography). There, the different modes of technology point to different ontological and epistemic (and for Kittler, political) implications (Krämer, 2006). Here, however, the representational quantitative view of a phenomenon come to take on the texture of qualitative data when considered at the scale and depth of big data. This shift from particulate and representational points of data toward an engaged form of interpretive and phenomenological being-with takes place along a terrain initially laid out by Simon (1969) in his assertion “that we often find quite different inner environments accomplishing identical or similar goals in identical or similar outer environments.” For Simon, this “[q]uasi independence [of the inner environment] from the outer environment may be maintained by various forms of passive insulation” (p. 8). In the case of the turn in big data, this insulation of the representative quantitative interior to the qualitative exterior is one which is achieved through the sheer scale and dimensionality of the data in question—a fact which disrupts a straightforward use of Simon’s consideration of an interior-exterior divide, rendering it more metaphorical than anything else. Big data occupies a unique space in the way that it, in most ways, functions internally as positivist data, providing an explicit Erlebnis. At the same time, however, the external environment relates to the sheer size, dynamism, and variety of the data in an interpretive fashion, being able to sustain an overarching Erfahrung. The internal representation is, for purposes of external function, received as a phenomenal occurrence, one to be confronted as phenomenological object.

This kind of phenomenological picture of big data is readily seen in the kind of filtering, manipulation, and multi-leveled analysis that such a large set of data provides. The ability to examine a set of data in a multi-dimensional fashion according to a variety of perspectives which each leverage the dynamic presentation of a phenomena in the data give an experiential realism to insights drawn from big data. As Edmund Husserl (1982) put it in discussing “mere 'modes of appearance','” “a core of 'what is actually presented' is
apprehended as being surrounded by a horizon of ‘co-givenness’” (p. 94). In the possibility for a dynamic engagement with “the horizon of ‘co-givenness’” that exist at the edge of the appearance of an object, big data gives the possibility for this phenomenological appearance within the confines of an empirically-derived system.

This is demonstrated in the work of interaction design in the way in which data concerning individual users gets compressed into the designer’s understanding of the impact of the application as a whole. The data is pointed and explicit (Erlebnis) when considered on the basis on an individual user, but taken together, the data provides the overarching situation of the application (Erfahrung). In this, designers come to live with the application and to understand it in a manner which points beyond what is explicitly found in data. Such data is not something that can be understood in either a piecemeal or isolated fashion; it is only able to be thought with, as a part of the work of design itself. Instead of considering the empirical characteristics of big data in their work, designers begin to think with the data as it comes to play the role of the background against which they interpret their work. Much in the manner described by Donald Schön (1992), this background of data (as Erfahrung) provides both the field within which they reflectively engage with the materials of design and (as applications take on more social and ubiquitous functions) the materials for design itself. For the designer, this field provides the conditions for their work. The next section builds on this in order to discuss designers’ relation to the field and how they “think with” the data in their work.

**Thinking Design with Big Data (and without Empiricism)**

As big data begins to take on this dual character of both material for design and empirical representation of the outcome of the work of design, it approaches a moment of peak empiricism. In this, the traditional empirical character of the (empirical) data begins, as it is used in the work of design, to fall away. Instead of functioning to mediate the relationship between subject (the designers) and object (the function of the application), the
data takes on an environmental character, providing scaffold for the situation, goals, and intent of the design. The humanist model of empiricism gives way to a post-humanist paradigm of a broader network of relations. Big data, in its own empirical nature, serves to undermine the metaphysical relation of subject and object on which empiricism relies. This changes the nature of the work of design, turning it away from one in which designers empirically evaluate the situation of use through data, to one in which *thinking-with* the data becomes the central focus of design work.¹

Critiquing the traditionally understood relation between “knower and known” (p. 133), we can use Barad's (2007) performative approach to provide an initial entry to understand the situation of big data:

> [u]nlike representationalism, which positions us above or outside the world we allegedly merely reflect on, a performative account insists on understanding thinking, observing, and theorizing as practices of engagement with, and as part of, the world in which we have our being. (p. 133)

When applied to the question of knowledge in design, however, this understanding of performance goes beyond the epistemic questions of “thinking, observing, and theorizing.” To design with big data is not to just understand, but to explicitly alter any situation that is understood. By wrapping such epistemic considerations within a performative milieu, Barad’s account begins to make a link between Hacking's functional epistemic orientation and the world-making *Erfahrung* of the data. For this vision of design, the epistemic uses of empirical data are more than epistemic: they are active in the way that the data is *thought*.

¹ While this is given particular rendering in terms of the domain of design, a similar account could be given in the social sciences. The work of social science research would thus be cast also as a mode of “thinking-with” the available set of big data generated from a particular area. This data would provide a measure of the historical horizon of a hermeneutic mode of scientific work (Bernstein, 1983). As noted earlier in the introduction, the concept of peak empiricism is perhaps suitable for any area of the human sciences beyond that of design which is used here in its development.
Such “thinking-with” is founded neither on epistemic rumination nor an isolated sense of practice. Thinking-with data engages both the paradigmatic mode of general theoretical background and the situated *Erfahrung* conditioned by big data, each of which support a kind of actively reflective and engaged design practice that includes both the designer and that which is to be designed in a single system.

**The Activity of Thinking**

In engaging with big data in the work of design, what comes to supersede any kind of imminent practicality is an even more fundamental approach to conceptual development in design. Looking to understand the influence of peak empirical data in design, it is important to remember Susanne Bødker’s (1998) definition of design as focused on “the creation of something new” (p. 108). Here, any data pertaining to the conditions of use serves to provide the space within which the possibilities of any system can be seen. The data does not so much compel any particular design decision as much as it opens the possibility for certain products of design to be developed.

Martin Heidegger (1998) provides some insight into this relation between thinking and acting as he argues that “changing the world in the manner intended requires beforehand that thinking be changed” (p. 338). In this sense, “thinking” comes to play a constitutive role in the enactment of any real change, both in the possibility of creation through design and recognition in use. This relation between thinking and the possibility of change resonates with Barad’s (2007) consideration of the relationship between “knower and known” (p.133) and counters Hacking’s (1983) reaffirmation of Karl Marx’s (1976) formulation of the importance of changing the world rather than thinking it. Here, Heidegger links thinking not only to a mode of epistemic practice, but establishes it as the fundamental condition for action of any kind, epistemic or productive. For both designers and the use from which it is drawn, the field of action laid out by big data comes to be a shared space of possibility. The
data provides an immediate and reflective basis against which the continuing activity of design functions. It is in the engagement of such a field of data that the work of design is understood to take place as “thinking.”

**Thinking as the General Condition of Design**

Thought, as a mode of performance (intuitive and reflective), becomes the general condition of design under peak empiricism. Explicitly, this is not to reduce the thinking of design to a kind of interpretive and representational thought as found in interpretive research or the consideration of specific theory. Instead, it looks toward a more foundational understanding of what both thinking and design are, establishing thought as a constitutive act (as design is already generally understood to be).

In characterizing this kind of constitutive thinking-with, Heidegger’s (1968) conception of the withdrawal of what is thought—of the escape of thinking from an immediacy of presence—begins to help us separate the forward-looking work of thinking as it is found in design from considerations of the explicitly present conditions as in the actual conditions represented in big data. As he formulates it in somewhat esoteric terms, the “event of withdrawal [of what is thought] could be what is most present in all our present, and so indefinitely exceed the actuality of everything actual” (p. 9). In this, design, as it *thinks with* the data, is not concerned with that which is present, but is instead engaged with a more fundamental concern for “the presence of what is present” (p. 244). That is, it is concerned with what constitutes that which comes to be. Leveraging Heidegger in this way, a performative act of design as thinking-with the situation established by the data brings on an active account of those conditions that make design possible. For Heidegger, the withdrawal of thinking “is an event” (1968, p. 9) which comes as “the essential occurrence of beyng”

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2 The arcane German term “seyn” is rendered in translation as “beyng” in order to distinguish it from a rudimentary sense of “being” (*sein*) and force an understanding of being which distinguishes between individual beings and a more originary *beyng*. This rendering of the “ontological distinction” is analogous
itself” (2012, p. 8). This echoes both Simon (1969) and Bødker (1998) in considering design as being concerned with a change that brings about something new: design is not concerned with what is present; it is concerned with a basic mode of presencing.

Viewed through the lens of a Derridean ethics (Critchley, 2014), design is the event in which thinking answers a call for responsibility from the alterity given by the data. Such responsibility toward those conditions that are yet to come forces the work of design away from the present. This thinking takes on the tenor of an original ethics of “human dwelling thought upon the horizon of the truth of Being” (p. 15). Design, when given over to the domain of large-scale empirical data, is to be understood as a “designing” rather than “design.” The active and performative work of thinking provides a basic account of design as something eventful, singular, and, as will continue to be developed, extra-subjective. The thinking of design takes place as an intuitive and emergent event constituted by the historical conditions set forward by the designer and the field of data together.

This formulation of the constitutive value of thinking is not without difficulties. Acknowledging Barad’s critique of Hacking’s assumption of individual entities, is there any support for understanding a singular and eventful occurrence—one which distinguishes itself from any other, as event? This critique pushes us back toward Derrida’s consideration of dissemination which exhorts us to face the present-ness of any event of thinking in a more radical way. This leads not toward a certainty of thinking (what it is, and how it functions), but away from certainty. Such a fundamental consideration of the network of interpretive valences at work in the determination of basic concepts and an acknowledgement of their social and historical determinations points to a weakening of metaphysics (Vattimo & Zabala, 2011) beyond even the subject and object or empiricism. For the concrete work of design,
this introduces a measure of doubt regarding the empirical appraisal of any solution. It highlights the question of the individual responsibility of design and the role that the designer plays in bearing this responsibility. This question of the conditions of the agentive founding of design is considered in the next section.

The Weakening of Agency in Design

The kind of radical weakening that is heralded in thinking about peak empiricism points to a fundamental reconsideration of the relation between empirical data and the way it functions in design. This is particularly the case when looking toward the agentive role of the data itself. As the empirical data moves from a traditional empirical role (as Erlebnis) to one which provides overarching support for a basic understanding of the situation of design (Erfahrung), its role in dictating the work of design is highlighted. In reworking the subject-object relation of empiricism toward a flattened ontology, big data forcefully presses the question of what it is to “think” as part of the work of design. Further, it questions how it remains possible to maintain a theoretical individuation of the subject and locus of individual action in the face of a weakened metaphysics. Under the conditions of peak empiricism, empirical data comes be explicitly understood as a necessary partner in the work of design, as material and situation. In this partnership, the thinking of design takes on the form of a non-discrete matrix of activity constituting a field of mutual agency shared between designers and the data with which they work.

In moving past the dictates of a traditional scientific epistemology, in peak empiricism, what a designer (as agent) does is bound up with the way in which they think with the data. No longer is data simply a tool utilized toward some effect (as Hacking might have it); it becomes a fundamental component of the kind of thinking that goes on in the work of design. This thinking is, as with both design and big data, linked to a fundamental view of progress and movement. Just as design is focused on that which is new, so is big
data, in its velocity, oriented toward action. Instead of relying only on an active sense of agency on the part of the designer, as data is *thought with* in the work of design, it comes to take on an agentive and active role, revealing the posthuman orientation of designing with big data. In Barad’s (2007) eyes, “[r]efusing the anthropocentrisms of humanism and anti-humanism, *posthumanism* marks the practice of accounting for the boundary-making practices by which the ‘human’ and its others are differentially delineated and defined” (p. 136). As in the performative approach she takes to epistemology, both “knower and known” (p. 133) have responsibility for what is. The “doing” of design (the thinking) is characterized by its eventful happening that instantiates any participants, and is not characterized by any *a priori* and precisely located do-er.

This re-framing of the conditions of design presents an important shift. Following Bruno Latour (2005), the work of design is no longer able to be characterized as either a social or material technical practice. The introduction of big data to design provides a context and situation for design in such a way that continues the progressive character of design, but without the arbitrary distinction between social need and technological possibility. Instead, design takes place, as event, within a broader field of material action. In this, the thinking-with the data of design directs the instantiation of the newness of design based on a shared matrix of social need and technological possibility. Diluting these boundaries, the use of big data in design forces a re-consideration of the relationship between effective design and the intention of design, and the relationship between thinking of agency and structure.

In proposing “a posthumanist account of performativity that challenges the positioning of materiality as either a given or a mere effect of human agency,” (p. 183) Barad (2007) reinforces a sense of agentive change. Radicalizing the concept of agency, she allows that “materiality is an active factor in processes of materialization” (p. 183). In this light, perhaps even the terms of any such discussion concerning big data and peak empiricism in
design should be reconsidered. Instead of thinking of design as a mode of techno-scientific practice (even as its objects are largely technological), perhaps we should, following Heidegger's (1977) consideration of the common origin of the terms *techne* and *poiesis*, re-invigorate our understanding of the work of design as being properly *poietic*, and approach the work of design as a mode of revealing which does not force its own point of view forward, but nurtures and draws out what is there in the data, allowing it to reveal itself. In doing so, we would weaken the concept of agency in design and complicate the relation between a designer, their work, and the user.

### Stepping Ahead

Contrary to what an increase in the availability of empirical data would initially seem to offer, big data does not carry with it an unlimited increase in empirical certainty about the situation of use. Nor does it offer designers consistently-increasing empirical insight into how to best approach any design problems. Instead, with its outsized scale and dynamic dimensionality, big data exhausts the possibilities of empirical insight and brings a debasing of the foundational theoretical position of empiricism of the direct sensuous link between subject and object. In harnessing the insight that it offers, big data presses for a new understanding of design as an event of thinking-with the data. More than anything, this moment of peak empiricism points to a future at which point designers trade some sense of agency for the power and reach that big data offers. This presents a kind of miniature Faustian bargain for the designer: gain the insight offered by the data, but lose some measure of agency to the data in the deal. Such a trade off presses us to carefully consider the goals of the work of design and attend to the ways in which our intentions may be re-shaped in the face of such vast data resources. This is not to warn off any serious considerations of big data in favor of a thoroughly humanistic view of the work of design, nor is it to capitulate to an overwhelming empiricism of data. Instead, it is to encourage a realistic and nuanced
understanding of the new position faced by both empiricism and design and to knowingly, if not carefully, step toward their future.
Chapter 5
Who is the Big Data Student?

The conditions laid out by the conceptions of a generalized technological practice and peak empiricism point to a certain kind of engagement with large scale data that force a reconfiguration of how such data may be productively engaged in the work of design. For online courses, and MOOCs in particular, this question of reconfiguration is linked to the ways in which the individual needs of students may be met in the kinds of learning environments which both generate and seek to leverage large scale data. In this chapter, a Heideggerian approach to the question of how big data can be used in the design of online courses is given a theoretical rendering. In this, there is a turn away from the kind of fundamental consideration of the uses of big data in design as detailed in the previous chapter, and a turning toward the specific question of the possibilities offered to the design of online education.

It’s Big Data Time for Education

As students engage with an online class, they leave a trail of empirical data behind them. Simply by logging in, downloading an assignment, making a comment, or taking a quiz, students provide an indication to course designers about what they think should be done at any particular moment. At each moment in a course, we are able to see what is commonly done (by individual students) in this or that situation. We can know if a significant group of students would read one text before another, watch a video before taking a quiz on the content, and so on. Independently, though voiced in unison, each student makes his or her own choices which, brought together, might give precious information to course designers. It is with this knowledge that a baseline of student activity might be developed, one that provides an account of average and ordinary interactions with a course.
For instance, a traditional online course with 25 students at the Pennsylvania State University had an average of 2.5 student interactions a day for 14 weeks. This course generated around 6,000 data collection points—6,000 data points in a class that was designed with no intentions of data collection and enrolled only 25 students. MOOC providers such as Coursera, which might have data collection as one of its main revenue streams, collect data about student interactions at a much higher rate. If we consider a Coursera offering with an average class size of 50,000 students and a completion rate around 10%,\(^3\) in a 14-week course we might have between 1.3 million and 12 million data collection points. This is big data for education.

In such a sea of data, a constant duality is at play between an image of the individual learner and the collective image of all the students in the class. The designer knows that a course is created for many students, but it is taken by each student individually. Ultimately, the experience of the learner is the experience of the individual student. However, the (big) data collected is about the many. After all, the possibilities found in the sheer volume of the numbers are what makes big data so appealing today. The challenge is to make the journey from the individual student—who is, for example, generating each interaction, taking each quiz, and clicking each link—to the larger group (or groups) of students—which, perhaps, spends the same amount of time in reading #3 or achieves 80% on quiz #4—and then back to future individual learners who will take the course and benefit from a better designed learning experience.

While a course is taken by individuals who approach learning in a subjective fashion, only objective points of data can be collected. The “I,” the individual student taking the course, is more than just what may be objectively known. All students bring to bear in their work in a course their past experiences, their present engagement, and expectations for the

\(^3\) See http://www.katyjordan.com/MOOCproject.html for MOOC completion rate data.
future. The student and his or her learning experience need to be understood from a fundamentally ontological perspective. That is, instead of being understood simply in terms of the signals and surface characteristics that can be immediately identified, it is necessary to look at the more fundamental conditions, motivations, and engagements upon which student performance is founded. While data collected about student performance provides an account of the present activities of the student it does not, in its initial and immediate form, provide the whole story of the student. A rigorous engagement with the data on the part of the educational designer is necessary in order to approach the more fundamental aspects of the individual student. What such an ontological understanding of a student provides is a holistic account of their engagement with the world. Rather than a factual account of their activities, it includes the trajectory of their possibilities and active engagements with the world.

This chapter develops a picture of how we can understand individual students by using big data. It aims to provide a theoretical and conceptual schema through which the needs of individual users can be identified through an analysis of data concerning a set of multiple users.

**Finding One Student Among Thousands: A Heideggerian Perspective**

One thing that is obvious in the development of MOOCs and the data that is generated from them is the large number of students involved. In traditional classrooms, or even in more traditional modes of online education, it is relatively easy for course designers and instructors to attend to the needs of individual students in a direct way. With MOOCs, however, the scale of the courses makes this practice impossible, and it is necessary to develop new approaches to understand students through the data generated by their engagement in their courses. In this chapter, I propose a way to understand individual students within the thousands who may be taking a course.
While big data provides a snapshot of what is going on at any moment (or over a series of moments) during a student’s learning, it is not able to capture the ontological character of each student’s individual experience of online learning. This ontological perspective of individual existence is what Heidegger (2010) called *Dasein*. Taken literally, *Dasein* means “being there” (from the German *Da*, “there,” and *Sein*, “being”). In colloquial German, *Dasein* means “existence,” but Heidegger used it specifically to refer to individual human being. He was not saying that humans have Dasein, however. Rather, he asserted that each of us is characterized by being individual *Dasein*. As Wrathall (2000) puts it:

We are a Dasein because of the way we exist in the world. Heidegger deliberately chose the term because of its literal connotations—Dasein always has a “there”, a place in which it understands how to comport itself, and within which it has meaningful relationships to other entities. No other philosophical name for human beings—names like “subject” or “rational animal”—is quite so good at capturing what Heidegger thinks is distinctive about us: that we always find ourselves surrounded by particular objects and items of equipment, and caught up in particular activities and goals, all of which contribute to making up a particular situation. (p.19)

In discussing the concept of *Dasein*, Heidegger (2010) noted that it is not about what the person is in term of actuality, but what his or her ontological possibilities are. *Dasein* is predicated on an involved engaged interaction with the world. It is the total course of involvement of an individual’s life—their cares, concerns, and interactions over his or her whole life toward death. Individual *Dasein* is not concerned with the simple facts of any individual person; it is about the temporal relationships that are built up over the course of individuals’ lives and the way in which these progressions and relationships have a distinctly human character. The mode of human involvement with the world is distinct from that of a rock or a dog. While each has its own way of being in the world, humans have a particular
way of caring about and being concerned with the world. It is this invested sense of care that provides *Dasein*'s unique character.

To understand the difference between what big data is capturing through the recording of each student’s interactions within a course and the extended view of the data that we are proposing, it is necessary to use two of Heidegger’s concepts—the *ontic* and the *ontological*. For Heidegger, the ontic refers to the plain facts of the description of a state of affairs. Ontically, a student may be male or female, old or young. They may take this class or that one, perform well or poorly in either. They may be from Canada or Uganda, speak Persian or Italian, have graduated from high school or not. These characteristics are all ontic facts of a student.

In the classic example, ontically, a hammer is (or was) made from a piece of wood of a certain shape with a piece of metal attached at one end. When viewed as such, in Heidegger’s terms, the hammer is considered to be only *present-at-hand*. Ontologically however, a hammer brings forward the possibility of the activity of hammering. When in use, the hammer is considered to be *ready-to-hand*. The ontological is not just a description of actuality, but of possibility. The ontological possibilities of the world are what make the ontic actualities possible, or in Heidegger’s (1997a) words: “What makes the comporting towards beings (ontic knowledge) possible is the preliminary understanding of the constitution of being, ontological knowledge” (p. 7).

To draw out this ontological perspective, I propose to explain the potential of big data through Heidegger’s concept of *Das Man*, or the collective of our ideas, norms, and ways of doing things that are so important to human understanding. First, however, it is necessary to introduce Heidegger’s question regarding the “authenticity” of individual *Dasein*’s actions, which lays out the ontological relation between *Das Man* and individual *Dasein*. 
Heidegger’s question of authenticity concerns the way in which individual *Dasein* may or may not engage with a situation in an authentic manner. Acting authentically means that each individual *Dasein* approaches the possibilities of a situation in such a manner that their decisions within that context are made on the basis of their own experiences and personal trajectory through the world over time. If individual *Dasein* does not act in this manner, it is said to have fallen into averageness. While the exact relationship of (and ultimate implications for) this movement between averageness and authenticity has been (and remains to be) a point of contention (Carman, 1994; Dreyfus, 1995; Olafson, 1994a, 1994b), what is important here is that Heidegger gives a name to that which steps in for *Dasein* as it falls away from authenticity and into averageness: *Das Man*.

Alternatively translated as “the One” or “the They,” *Das Man* functions to relieve individual *Dasein* of its decision-making responsibility, providing an account for what should be done in any given situation so that individual *Dasein* need not make its own choices. In relying on *Das Man* rather than their own, uniquely-situated faculties, *Dasein* falls into averageness and away from authenticity. In ceding the opportunity to make authentic choices, *Dasein* simply follows along with what “one” would do in any given situation. Instead of following its own unique path, *Dasein* acts in an average fashion and does what “they” would do in any situation. *Das Man* does not function as a universal subject that actually makes decisions. Rather, it is a necessary constituent part of *Dasein* that makes social interactions possible. By laying out average approaches to the world, *Das Man* pushes individual *Dasein* away from authentic action and authenticity, but also provides necessary insight into how others approach the world. To what degree such averageness is necessary for social action is open for debate, but what is clear is that in *Dasein*’s authentic decisions, there is nevertheless a reliance on the kind of shared meaning that *Das Man* provides.
Central to the question of how to engage individual students in online education is the question of how we should understand online learners themselves. Instead of approaching users as simply represented in points of data, in this chapter we develop a fuller picture of the online learner, one that is based on the Heideggerian conception of the human being, Dasein. A more robust understanding of human beings is called for, particularly in that online learners are much more than just individuals who are engaged in an online class: They all have reasons and motives for engaging with the material of the course that extend well beyond their interactions in the course itself.

It is useful to contrast a rigorously developed picture of Dasein (as defined in Heidegger’s work) with a simplified caricature of human activity that, while ultimately inaccurate, provides a sometimes necessary simplification of human beings and as such often remains as a pervasive ideological backdrop. This caricature presents a human being only in terms of its qualities, as a static collection of data points which may be accurately, and meaningfully, described. From this assertion it then follows that human behavior may be meaningfully and wholly understood through the analysis of data. At bottom, this atomistic and Cartesian understanding of individuals fails to offer a realistic picture of human activity (Dreyfus, 1991).

In contrast, I propose an ontological view of human beings as developed by Heidegger (2010), understanding the human being as Dasein. For Heidegger, Dasein is the existential possibility of human beings. Rather than being concerned with the ontic facts and details of the human being, Dasein is concerned with the ontological setting of the human being: the way that the individual makes meaningful sense of the world in an engaged and situated fashion. In its constitution and in the accounting of what it is, Dasein is defined by its engagement with the world. This engagement with the world is one of a fundamental state.
of care and investment in the world. It is not possible to separate the individual from the context of its actions and the possibilities that accompany such a context. While acknowledging that characteristics do exist, and individuals may be described by these characteristics with a certain modicum of accuracy, it is asserted that prior to the possibility of any such description there exists an ontological determination of the field of possibilities. That is, previous to a descriptive and ontic account of human beings is an ontological account of Dasein. As Heidegger (1962) explained:

As opposed to the theoretically concocted "explanations" of the presence of others, which easily urge themselves upon us, we must hold fast to the phenomenal fact which we have pointed out, namely, that they are encountered in the surrounding world. This nearest and elemental way of Dasein encountering the world goes so far that even one's own Dasein initially becomes "discoverable" by looking away from its "experiences" and the "center of its actions," or by not yet "seeing" them at all. Dasein initially finds "itself" in what it does, needs, expects, has charge of, in the things at hand which it initially takes care of in the surrounding world. (p. 116)

As such, here we are concerned with this formulation of the human being: as Dasein, as that which is previous to, and ultimately determinate of, the ontic actuality of the student. After all, “[h]igher than actuality stands possibility” (Heidegger, 2010, p. 36). We are interested in the development of the possibilities contained in individual students as they are engaged in online education and so must look beyond an ontic description of each student.

Taking the Analysis of Big Data from the Ontic to the Ontological: Finding Dasein Among Das Man

By itself, data concerning an individual student cannot provide any ontological insight into the development of an individual student as Dasein. While information pertaining to individual students might be helpful for educators in a small class, extracting all student
profiles from a course of 100,000 students would not facilitate the work of an education designer. At such a scale, the individual consideration of each student is simply unmanageable. Sampling a handful of profiles or concocting an averaged picture of the student population of 100,000 would not help the designer, either, as such approaches would miss the individual student as Dasein.

However, more than just presenting students as a simple, aggregated, and nameless whole, big data gives us a representation of the student body as it is constituted of individual students and their individual interactions. What is seen in the data are not students acting consciously together as a group, but individuals acting independently within a common field of possibilities.

Looked at directly, the raw picture of students and their groups provided by big data is unable to provide an ontological view of either Das Man or Dasein. While big data is able to provide an aggregated snapshot of each student, this snapshot is not a representation of individual Dasein: Even though a student’s individual activities can be seen in the data, his or her ontological intentions and motivations as Dasein are not. Similarly, even the understanding of Das Man offered through big data is not able to achieve an ontological status since it only has a tenuous relationship to the lived experiences of individuals, however average Das Man may appear.

Big data is, however, able to give a limited, ontic representation of Das Man by virtue of the way Das Man functions as a collective orientation toward the world. Specifically, it offers a picture of what individual students do in this or that situation given the possibilities presented by an online course. It is possible to see the way in which students, while acting independently, still share common approaches to the materials in a course. In this way, an ontic representation of Das Man can be understood: To a certain degree, students all interact with a course as it should be interacted with. Here, big data does not give an ontological
account of what the students do, only an ontic one which traces an outline of the ways their behaviors signal a common and shared understanding. At the same time, big data is also able to give a series of retrospective ontic snapshots of the ontological activities of individual Dasein. The wholly individual and historically situated actions of Dasein, however, remain opaque to any data-driven analysis, even as students’ activities may be considered on an individual level.

As was noted previously, the picture of Das Man found in the data is not “something like a 'universal subject' which hovers over a plurality of subjects.” (Heidegger, 2010, p. 125), nor is it simply a larger category or “the genus of an individual Dasein” (Heidegger, 2010, p. 125). Das Man, and the picture given by big data, are constituted by the actions of individuals as seen in aggregate. To understand Das Man and big data in this way is to have “an ontology of objective presence” (Heidegger, 2010, p. 125), rather than the deeper ontological view which makes understanding Dasein possible. It is this deeper, ontological view of Dasein and Das Man that we are looking for in order to be able to design authentic learning experiences. In particular, beyond gaining an ontological insight, we look toward the question of how to distinguish Dasein from any understanding of Das Man.

The limited and ontically representative view found in big data is, of course, anathema to the fundamentally temporal and situated way in which Dasein functions. In big data, we are only given glimpses into the activities of individual Dasein, while, to really understand Dasein, what is needed is a constant and holistic understanding of Dasein as it carefully navigates the possibilities offered to it by the world. Individual Dasein—and the insight into it that might be found in big data—can only be understood in the specific situation of its immediate context. To look at it any other way distorts this fundamental understanding of how we are to conceive of human beings.
To establish a means by which to draw from big data an understanding of the *Dasein* of students, it is useful to consider the way in which Dreyfus (1991) approached the positive role of *Das Man*, albeit from a different direction. For Dreyfus, rather than seeing *Das Man* as purely a limiting image that functions to only drag *Dasein* down into averageness, *Das Man* also constitutes the field from which *Dasein* is able to reach up toward authentic and creative action. For Dreyfus (1991), that *Das Man* gives everyday guidance to *Dasein* does not mean ... that the roles, norms, etc., available to *Dasein* are fixed once and for all. New technological and social developments are constantly changing specific ways for *Dasein* to be. Nor does it mean that there is no room for an individual or political group to develop new possibilities, which could then become available to the society. But it does mean that such “creativity” always takes place on a background of what one does—of accepted for-the-sake-of-whichs that cannot all be called into question at once because they are not presuppositions and in any case must remain in the background to lend intelligibility to criticism and change. Just as it is possible to find something occurrent and then give it a use, but only on the background of shared practical activities, so here too we have a case where ontic activity can create a new role or meaning, but only against an ontological background that is not subject to willed change. This sociocultural background too can change gradually, as does a language, but never all at once and never as the result of the conscious decision of groups or individuals. (p. 161)

In considering big data, however, we are faced with the inverse problem. Rather than being interested in understanding forward-looking creativity, we are looking backward at how, out of a fixed background of ontic information (the data), we might be able to reconstitute, in some form, the ontological movements of individual *Dasein*. Instead of refiguring ontic cultural activities against “an ontological background that is not subjected to willed change,”
we are faced with the question of how to draw Dasein out from the obfuscation of a mass of ontic data.

Toward this end, two insights are particularly powerful. The first comes in the way in which Heidegger (2010) characterized Dasein:

Dasein is a being that does not simply occur among other beings. Rather it is ontically distinguished by the fact that in its being this being is concerned about its very being. Thus it is constitutive of the being of Dasein to have in its very being, a relation of being to this being. And this in turn means that Dasein understands itself in its being in some way and with some explicitness. It is proper to this being that it be disclosed to itself with and through its being. Understanding of being is itself a determination of being of Dasein. The ontic distinction of Dasein lies in the fact that it is ontological. (p. 11)

In other words, “Dasein’s activity—its way of being—manifests a stand it is taking on what it is to be Dasein” (Dreyfus, 1991, p. 15). Dasein is what it is in the way that it is self-interpreting (Dreyfus, 1991). Here, what this assertion indicates is that a purely data-centric view of Dasein cannot be achieved. We must always have the input from individual Dasein in order to recognize Dasein. There will never be an objective set of data in which it is possible to see individual Dasein.

The second insight comes in the way in which Dasein “is ontically distinguished by the fact that in its being this being is concerned about its very being.” (Heidegger, 2010, p. 11). The relationship between Dasein and the world is one of care. Dasein, in whatever it does, rests on the condition of possibility of a caring engagement with the world. This is not an ontic care, such as whether my favorite baseball team has a winning season this year, but rather an ontological care, one that without which I would not be able to say whether baseball even exists. Dasein’s care for the world is indicative of its involvement with the fundamental
issue of the Being of the world. To distinguish *Dasein* from the ontic representation of *Das Man* in big data, it is necessary to, in some way, engage *Dasein* so as to reveal its caring orientation toward the world.

Combining these insights, a direction for understanding the individual *Dasein* of students through big data begins to develop, one centered on the designer’s active engagement with the data in the design process. If designers (each in their own *Dasein*) interact with the ontic representations provided by the data in such a way that they are able to engage the caring nature of students’ individual *Dasein*, students’ individual *Dasein* begins to be distinguished from the ontic representation of *Das Man* so evident in the data.

**Big Data Implications for the Design of Education**

Such a representation of *Das Man*, taken as just a representation, does not, however, provide an ontological account of the student. In order to achieve an ontological account, one that considers the possibilities of individual students, it is necessary to use big data captured from MOOCs in a way that affects students’ experiences within the online learning context. Big data is understood ontologically through the way it is meaningfully put to use (Bizer et al., 2012; boyd & Crawford, 2012). Through this meaningful use, big data becomes doubly ontological. First, as designers engage the data as a resource with which they interact and becomes a part of their work—rather than as something simply theoretical that provides a descriptive understanding—big data reveals its ontological character as something in the world. In this way, as in Heidegger’s (2010) example of working with a hammer, big data is not limited to being descriptive data; it becomes enmeshed in the possibilities of the intent of the designer’s work. To an extent, the designer forgets the data as data, and it is instead just part of their work as a designer, creating systems for education. To use Heideggerian terminology, big data becomes “ready-to-hand” for designers as they enter into the kind of seamless engagement described above.
Second, through the designer’s ready-to-hand use of it, big data collected from students exceeds the purely ontic description of *Das Man* that it initially provides, and, through the designers’ integration of the data into the experiences of students, the initially ontic descriptions of *Das Man* take on an ontological character. That is, as designers use big data to intervene in the progress of a course (making changes to the course in medias res), and the data, as a reflection of student action, becomes entangled in the ways in which students are confronted with possibilities in a course, the data comes to play, in a meta-ontological sense, a role in the emerging possibilities of student action. Key here is the kind of velocity that big data is able to attain, and how designers are able to tap into the data as a ready-to-hand tool and effect change in the progress of a course. It becomes a matter of how, as described in the previous chapter, designers come to think-with the data.

For individual students, as the big data collected about their activities (as ontic representation of a collective impulse) is put to use, the effects of the designers’ work with their data comes to function as a sort of call and response. In this way, there is a sort of inverse of the relationship that designers have with the data. As designers approach the data in a ready-to-hand fashion, using it as a tool to make active interventions in the course, the students feel these effects in a substantive way. From the perspective of the designer, it is not the individual student who is subject to the changes, nor is it the individual student who responds to the changes and whose activities are altered by the new possibilities offered in the design. Neither is it the individual student who is seen in the data. Rather, designers find themselves engaged only with the image of *Das Man* provided in the data. While individual students, in their own private actions, confront the new possibilities offered by changes in a design, these responses are only seen by designers when individual students, through their autonomous action, come to shape *Das Man*. 
In looking beyond this exchange for the possibility of an ontological approach to student data, one that addresses Dasein more so than just the Das Man of the students, Descartes’ (2001) example of a blind man’s use of his cane as an extension of his sensory apparatus is helpful. In grasping the cane and running it along the ground, a person without sight, despite the cane’s artificial mediation, still receives ontological signification of the ground through the cane, without being concerned with the ontic representation. The cane does not provide a picture of the ground for the person walking along; it simply provides an understanding of the terrain. In Heideggerian terms, the cane, as being ready-to-hand, comes into proximal being with the person using the cane. In a sense, the cane becomes an extension of the person feeling his or her way along, providing the linkage between sensing subject and the object of touch.

Placing this metaphor within a Heideggerian unification of subject and object in Dasein, when students are, in a sense, poked through the interventions of the designer (as their work is based on the big data collected from students), students’ reactions, however they may fall under the guidance and rubric of Das Man, become temporalized along the continuum of the data collection. This relationship is the case no matter how small a slice of the total appreciation of the historical and personal tradition and experience of students is at stake. No matter the scale, when all are brought together into this temporal circuit of monitoring and effect, the students, the data, and the designers all coalesce into an ontological picture of activity in the truest sense: They are neither individual designers, bits of data, nor students. Instead, they constitute the body of ontological online education. In this way, the ontic representation of Das Man is able to be turned into an important and ontological part of the system of online education, one that brings individual students to confront the implications of Das Man in a way rarely made more overt. The “stick” of the
data concerning the ontic representation of *Das Man* gives designers a chance to come into an ontological relationship with the students.

This ontological outcome is achieved through the studied and skillful work of the designers as they modulate collection of data, as it pertains to all students, with an attention toward the function of the data of each individual student. In this manner, the larger set of data concerning the whole of the student-user base is, through the intuitive and *phronetic* work of the designer, applied in a sparing manner to the design in ways that allow for the picture of *Das Man* represented in the data to fulfill its positive role of enabling a coherent social communication and an intelligibility of use. That is, there are some aspects of online education that would be common to all students, such as the size of buttons or the organization of course information. Data from individual students, though still contributing to the wider picture of the representation of *Das Man*, is also simultaneously approached as indicating toward the path of the individual student and is seen as ontically representative of only the individual student.

However, when the data is used as a ready-to-hand tool and in the right ways (as in the *phronetic* manner described in chapter 3), a subtle transformation takes place in the way in which the representation of the individual student is able to function. Instead of being an abstracted and reduced representation of their activities, the information can be tied back into their interaction with a MOOC and the whole of their experience of online education in such a way that it plays a real and ontological role in their development as a student. By establishing means for the data to feed back into the design of each individual student’s learning path (in the work of continuing design, for instance), the data are no longer simply a representation, but something with ontological import of its own. As big data is utilized to modify the course, and additional data are collected and the cycle of data collection is
repeated, the data take on a lived relation to the individual *Dasein* of the student and become bound up with him or her. As Heidegger (2010) described it:

The “description” of the surrounding world closest to us, for example, the work-world of the handworker, showed that together with the useful things found in the world, others are “also encountered” for whom the “work” is to be done. In the kind of being of these things at hand, that is, in their relevance, there lies an essential reference to possible wearers for whom they should be “made to measure.” Similarly, the producer or “supplier” is encountered in the material used as one who “serves” well or badly.

(p. 114-115)

For designers, the online student has the double relation of both those “for whom the 'work' is to be done” and the “producer or ‘supplier’” of the data used in the work of design. Used as such, the big human data collected from students brings designers to encounter the being (the *Dasein*) of the students.

Through this process, what could be taken as an ontic representation of the collective sense of *Das Man*, as an index of what should be done at any point in an online course, is made into a living, ontological engagement with the individual *Dasein* of the students—one that addresses the individual learner as an ontological entity. What is central in this approach is that the big data collected from users is not viewed as a symbolic representation of the state of affairs as it is, but rather as a derivative representation which, as a tool for designers, is itself part of the experience of the learner. The representative stance of the data undergoes an ontological shift when it is understood and used as such. It is the task of the designer to approach and work with big data in such a way that the data are handled as part of the extended possibility of students—that the data are not something distant from the student, but that are connected to their online interaction, able to flow back to them in the form of a reshaped and changing course. Just as the data is, as described in the previous chapter,
ontologically part of the situation of design, in this way, the data is ontologically part of the
situation of use.

**Conclusions**

When students are understood as individuals, with unique trajectories in the world, the data collected from their online course interactions presents a unique opportunity for designing online education. Imagine what is seen as the gold standard of education: one-on-one personal instruction from a qualified instructor. In this context, designers and instructors are able to respond to a student’s developing needs, offer suggestions and assistance as it is needed, and give the student enough space to learn on their own. In this way, the student is allowed to respond to the lessons totally from his or her own perspective, in an authentic manner through which each response opens up new possibilities for learning.

At first glance, MOOCs seem to present a radically different picture from that of one-on-one education. Not only are instructors and designers dealing with thousands of students, but their interactions are dependent on the large sets of data generated by student activity. Here, the goal has been to understand how to use big data in online education in such a way that the developing possibilities for students, as individual learners, are addressed. The big data generated through MOOCs should not be seen as only providing a static snapshot of what is going on in a class or with an individual student. The data need to be understood as giving a keyhole view into the full experience of a student, one that is predicated on the opening horizons of possibility rather than one that limits and averages students’ possibilities. The negative aspects of the collective representation in the data that limits students to an average path should be avoided, and the possibilities of each student’s individual trajectory need to be taken seriously. The data need to be understood as a tool by which designers can appreciate the authentic choices made by students as they interact with an online course. If the designers use the data as an instrument with which they can engage with the varied and
developing situations in which students find themselves, they can better offer students authentic learning experiences. A set of a thousand test scores alone is not able to give instructors and designers deep insight into students, but when those scores are coupled with other scores over time, and this larger set is understood in relation to the reflective activities of the designer, deep insight into the students can begin to emerge. By approaching the data itself as an active part of the design process and establishing connections between the causes of design and the effects seen in the data, students can over time be brought into a dialogic engagement with courses. By thinking-with the student data, it is possible for designers and instructors to ethically and eventfully engage in the work of design. In looking at this use of student data, the question remains as to what this data looks like and how designers come to see understand the students in a course.
Chapter 6

Developing a Typology of Critical Incidents in the Design of MOOCs

The theoretical and philosophical framings developed in the previous chapters point toward a picture of the work of interaction design that is driven by a historical unfolding of events that extend over and above any sense of individual agency on the part of the designer. In the case of interaction design, this historical unfolding finds its entry into the work of design most immediately through the analysis of data and feedback from users. The conditions for design established by the use of this data assert themselves more directly as these sets of data become larger and the use cases being designed for come to be more intertwined with a wider sphere of social activity. For designers, large sets of user data become their window into the world of social interactions that make up the material of their work. This data also becomes the tool through which designers are able to come to understand users in an authentic way. The large sets of data that are engaged by designers as part of their work come to play an equally constitutive role in the social cycle of design and use. Through the analysis of user data, the activities of users and the ways in which they engage with a system come to play a central role in the design of a system. As much as design may be characterized as an eventful process, so too in this way does the use that is abstracted in user data take on an eventful character. In this formulation, however, the question remains, in cases of social interaction design which are guided by large sets of user data, what do these events of use that punctuate the shared work of design look like and how can they be understood?

In order to answer this, I look to the specific case of the design of Massive Open Online Courses (MOOCs). MOOCs offer a particularly excellent case for illustrating the theoretical underpinning of design laid out in that they offer an emerging paradigm for use
that is both deeply entangled with strongly-established social structures (education) and are contained an environment rich with user data and feedback. In their novelty, MOOCs present a case in which both the design and the use cases being designed for are each still being determined, one affecting the other (as in the model of the Task-Artifact Cycle (Carroll et al., 1991)). In this, MOOCs provide an example of the design of socio-material systems in which the traditional locus of design agency may be tempered by an engagement with large sets of user data.

While the volume of the data collected in MOOCs (and analyzed here), may not necessarily yet reach the heights of big data for some observers, the limits of ordinary appreciations of data are stressed in the experience of both the design and use. Further, focusing on a contemporary situation of design and use, the present case does not fully exemplify the coming moment of “peak empiricism.” Rather, it is seen to exemplify an early form of the kind of empirical overcoming that has already been laid out. It is an example of the heralding of relations to come, not a fulfillment.

Nevertheless, the case of MOOCs presents the opportunity to look into the influence that large sets of data can have on the design of large scale socio-technical systems. In doing this, the study of MOOCs allows for the relationship between the work of design and large scale user data to be sketched out. In looking at student data from MOOCs, it is possible to get a view into the kinds of data that designers “think with” as they work out the meanings and social functions that permeate a large, online, socio-technical system.

The work of designers as they think with traditionally-scaled materials for design has been well documented (Cardoso, 2009; Cross, 1997; Dorst & Cross, 2001; Schön & Bennett, 1996), but the specific character of materials engaged in the design of a large scale online system present a unique case. As earlier, designers in these instance are not as immediately concerned with the technological material of the system as much as they are concerned with
the social arrangements that form around the materials of computer technologies. In this, MOOCs provide an example of the kind of design discussed in previous chapters: their design is more about the social structures, values, and purposes of education that are developed than the actual technical components of the system, with designers working with social materials in a reflective manner rather than just plainly physical materials. The purpose here is thus to identify these materials and the ways in which they assert their role in the work of the design of socio-technical systems.

**General Approach**

In order to understand and provide an account of the ways in which these social materials mix with and engage the design of a socio-technical system, forum data from three MOOCs is examined. For MOOCs, the forums provide a central location for working out the functions and meanings associated with the paradigm of massive online courses. For both the designers (including instructors, instructional designers, staff, etc.) and users (students), the forums serve as a resource for connecting with and engaging with others both topically about the course materials and, more importantly, about the overall function of the system of online education presented. Central to this is the fact of the near-constant engagement and dialogue that occurs in the forums and the level of rich feedback offered. To focus this explication of the data, a typology of the kinds of critical incidents found in MOOCs will be developed. These incidents chart the historically-constituted events that engender the configuration and reconfiguration of the shared material and immaterial constitution of the online systems. They provide a view into the social forms that are presented in the course data.

The analysis of these kinds of critical incidents has a rich history in the study of technology and interaction design (Castillo, Hartson, & Hix, 1998; Urquijo, Scrivener, & Palmén, 1993; Wright & Monk, 1989) and are often conducted under the guise of an analysis.
of “breakdowns” (Winograd & Flores, 1986)—those junctures in which the use of a system fails. Critical incidents are particularly useful in cases in which either a distant evaluation of users (though system logs, for instance) is necessary (Castillo et al., 1998; Wright & Monk, 1989) or in the face of a vast amount of data in need of an organizing paradigm (Urquijo et al., 1993). The situation given by MOOCs, it should be noted, presents each of these conditions. In previous education research, critical incidents have likewise been used to orient the analysis of a large set of data (Angelides, 2001) and have further been specifically used in order to elicit the reflective development of critical judgment (Tripp, 1993).

Unlike much previous work in interaction design, instead of looking to critical incidents in order to gain insight into what constitutes an effective design for a final product or set of practices (as in an “effective” system of online education, for example), here, by developing a typology of critical incidents, the aim is to simply gain better insight into the conditions of design in an era of large-scale user data. That is, by tracing the breakdowns of use that are illustrated in the forum data, the purpose is simply to identify what went wrong in any given case, but to use these incidents to leverage some greater insight into the work of design. This has two aims. First, by relying on forum data in order to develop this typology, it will be possible to illustrate how these incidents appear to the designers and instructors responsible for an online course. This analysis presents the opportunity for understanding how individual points of data come to elicit a response in the work of those seen as being the traditional locus for design agency. Second, by describing these incidents in abstracted terms, this typology creates a rubric for understanding the character of these user-centered events which guide the kind of progressive design found in the development of large scale social computing applications. Beyond designers, however, these critical incidents serve as an edifying ground on which an understanding of the ontological and epistemic field of agentive action in the work of design occurs. As will be developed, they serve to chart out the
trajectories of the development of large scale socio-technical systems as such systems are subject to the agentive work of both design and use.

In order to abstract this typology of incidents from a large set of data in the context of a still-developing paradigm of interaction, a novel methodological approach which finds a mid-point between analytic induction and grounded theory is utilized. In appealing to the kind of pre-theoretical analysis emphasized by both analytic induction and grounded theory, it is important to immediately note two things.

First, while previous chapters have explicated a theory of the eventful nature of design and the role that large scale data plays in the development of such events, what is at stake here is not an application of this theory, but the development of an example of this theory at work. That is, the typology of critical incidents to be developed does not illustrate the function of the theoretical perspectives developed, but instead extends and continues their development. As they appear in an abstracted fashion, the shapes cut by the critical incidents and their interactions with the work of design are a (again abstracted) continuation of the theoretical apparatuses developed in previous chapters. This empirical research into the design of MOOCs is not presented as a kind of theoretical evaluation or validation, but as a further fleshing out of the theoretical concepts already developed. That is, in developing a typology of critical incidents, the theoretical picture developed in previous chapters is not used to explicitly guide data collection and analysis (as in traditional models of qualitative research (Lee & Baskerville, 2003; Trauth, Quesenberry, & Huang, 2009)), but is meant to lay out the ontological terrain in which the work of design operates and in which critical incidents develop. The typology developed in this chapter comes to light without the explicit guidance of a theory of types and serves as example within the larger theoretical perspective developed.
Second, while methodologically following the atheoretical perspective required by something like grounded theory, it will be necessary to discuss the sometimes problematic framing that this kind of methodological commitment relies on. While the identification of critical incidents is performed in an atheoretical manner, it becomes necessary to understand the epistemic chain that nevertheless links this typology to some form of theoretical framing. While, this issue will be discussed in more detail below, what is important to recognize here is that the typology developed here has a unique relation to the theoretical framing developed and represents a kind of topological charting out of the actual conditions of the event of thinking-with data in the work of design. As such, while working within the developed theoretical terrain, the specific features of such a terrain are developed only from the grounding of the data.

The material aims of this research is two-fold. First, through this analysis of the events that take place in these online courses, a typology of critical incidents specifically germain to the design and execution of a MOOC will be developed. In doing this, there is an overt benefit to those seeking to understand the phenomena of MOOCs and how they are to be designed. Second, this analysis provides an opportunity for the specific illustration of the unique ways in which the work of design emerges out of a situation of large scale data. This illustration seeks to show the socio-material forms designers encounter in their work.

**Research Context**

In order to understand socially-embedded interaction design in the context of large scale user data, I looked at course data from three massive open online courses all being run for the first time at a major American public university. All three courses were designed and run using the Coursera\(^4\) MOOC platform and all were the first MOOCs developed by the instructors and design and support staff involved. The courses were open to registration from

\(^4\) [https://www.coursera.org/](https://www.coursera.org/)
students from around the globe, and had initial registrations ranging from 45,410 to 69,867 students, a smaller percentage of which remained active in the courses.

The courses were chosen from a field of convenient research opportunities, with three different courses selected on the basis of the diversity of their topics and the different kinds of student involvement that those topics encouraged. The three courses chosen were a visual fine art course (Art), a geospacial course (Maps), and a course focused on the relationship between energy use and the environment (Energy). All three courses were explicitly developed to offer an introduction to their topics at a level analogous to an introductory college level course. Though sharing a common platform, each course was designed and organized according to the particular demands of the topic and the pedagogical intentions of the instructor:

- The Art course provided instruction in both the history of visual art as well as the practical craft of visual art, focusing on drawing, painting, and collage. It offered both standard and studio tracks, in each of which students were responsible for readings and quizzes, with the studio track requiring the submission of students’ own artworks for peer review by other students.

- The Maps course focused on providing students with both a historical-theoretical understanding of the design of maps and practical experience using online geospacial information systems. In it, students were tested on both their understanding of map making theory as well as the function of GIS tools. There was an emphasis placed on students engaging in dialogue around maps and exploring the role that mapping technologies play in contemporary society around the globe. Beyond quizzes about the material, students were also required to design and present maps of their own creation, with the final project being subject to peer review.
• The Energy course presented material relating to the relationship between energy production and use and the environmental impacts of traditional, contemporary, and nascent modes of energy production. It focused on developing a student's understanding of the relationship between energy use and the environmental effects that resulted from energy production. The course placed an emphasis on students' response to and personal reflection on the course materials, with students being quizzed and tested on the information presented. Unlike the other two courses, while there was a final project for the course which involved the creation of an energy profile for a country, there was not the same emphasis placed on learning particular technical (either artistic or geospatial) skills.

Each course featured a mix of textual and video instruction, with quizzes and exams which tested students on their understanding of the material. The courses differed in their approaches to quizzes, however, with some allowing unlimited attempts with the student's highest score being reported, others offering only a limited number of attempts. They also differed in the level of required peer engagement and grading, with the Art course relying most heavily on Coursera's system for peer review. All three courses placed an emphasis on discussion and sharing in the course forums, with student use of the forums strongly encouraged, and, in the case of the Maps and Energy courses, required.

Each course studied was being run for the first time and as such offered an excellent view into the development of a novel socio-technical system. Existing entirely online, the courses offered a rich record of student engagement with the course and an opportunity to have access to a large sets of user data. All student activity in each of the courses (forum posts, quizzes, assignments, etc) was captured in a MySQL database that was used to support the course.
Through informal interviews with instructors and designers involved with the course, as well as through attending and viewing public discussions surrounding the design and facilitation of such courses, it became apparent that, for MOOCs, the course forums contained the richest source of data for understanding students' engagement with the course. Unlike other aspects of student interaction present in the MySQL data (such as student performance and interaction data), the forums provided a semantically-intelligible view into the function of the human system of the course. In the forums, by creating threads, posting to existing threads, and commenting on other posts, students were able to engage with other students as well as the instructors and designers involved with the course. The forums were host to discussions both directly related to the topic of the course and those that responded to course policies and their design. Importantly, instructors and designers responsible for the courses all pointed to the forums as being the locus of their attention when it came to understanding how the course was functioning.

Beyond providing a way to access dialogue between and among students and instructors, the forum content tables in the MySQL database also included user technical error reports, reports of typos and factual errors, and user flags of posts for bullying, threats, and other problematic behaviors. In this, the forum data presented the most direct access into user attitudes toward and understandings of the function of the course and offered the chance to understand student experiences and engagements with MOOCs in a rich manner.

**Method**

In order to understand the design of a novel system of socio-technical and data-led interaction and to come to understand the field of events which drives the mutual interaction between users and designers in a process of technology design, the forum data from the three online courses was subjected to a unique form of analytic induction in order to develop a typology of critical incidents. Such incidents are seen as a driving force in the developing
socio-technical understanding that forms the mode of design considered here. Conceptualizing design as a social practice centered around both traditional agentive loci (as in the model of a designer who works independently to produce a finished product) and social processes of use and engagement, these incidents reveal moments in which the common space which the product of design inhabits (the course) come to light as designers and users negotiate the meaning of a system. These critical incidents point to moments in which a lack of coordination of intelligibility across a socio-technical system produces the designed artifact, as both emergent and material object. In this, the typology of critical incidents that is to be developed is meant to trace a set of pointers or signposts in the process of “working out” the design of this novel paradigm for online education.

Before laying out the details of the present analysis of critical incidents, it is important to situate the specifics of the qualitative method utilized and this research's reliance on trace data. The importance of explicit discussions of these issues is elevated by the large and unique set of data being utilized.

**Between Analytic Induction and Grounded Theory**

In approaching the analysis of a novel set of data in a largely theoretically-undefined space with the aim of identifying a typology of critical incidents therein, there is a specific question as to whether this research represents a mode of analytic induction (Ratcliff, 1994; Robinson, 1951) or of grounded theory (Glaser & Strauss, 2009; Urquhart, Lehmann, & Myers, 2009). Each spring from a common methodological linage (Hammersley, 2010) and each seeks to approach a novel phenomenon with a certain measure of theoretical naiveté. Nevertheless, there remain some important distinctions between the two.

As Martyn Hammersley (2010) describes it, the two approaches are related, but differ in their intended outcome. On the one hand, analytic induction seeks testable results, whereas grounded theory seeks only a description of local phenomena. When considering the aims of
this research, this distinction becomes clouded by the question of what constitutes a test of
the results. Is a result considered validated when it is shown repeating within a single course,
across three courses, or does it need to be tested across a number of different courses in
radically different conditions? This distinction in the testability of results is further strained
(and in a more fundamental and unavoidable way) when considering the type and size of the
data being analyzed. The size of the data sets worked with here provide an entire terrain
against which codes, causes, and sets of theory can be both developed and tested internal to
the local phenomenon itself. That is, the local phenomena of a single MOOC (or in this case,
three MOOCs) is a phenomena that is rich and large enough that it provides opportunity
within itself for an iterative testing of the theoretical aspect of the phenomena (the critical
incidents) being addressed. Codes and theoretical relationships developed close to the outset
of the analysis are in effect tested against data later in the analysis.

The issue of the scale of the data approached in analysis highlights another difference
between analytic induction and grounded theory relating to their tolerance of exceptions
within the data (Hammersley, 2010). While analytic induction looks for a stricter and more
specific systematic theoretical development, grounded theory is understood to be tolerant of
discrepancies within any coding schema developed, a tolerance which aligns with grounded
theory's aims of developing a more specifically-descriptive theoretical framework than
analytic induction's universal and specifically-explanatory theory. This issue dovetails with
the first described above, with the comparative looseness of grounded theory's output
matching the local target of its analysis, whereas analytic induction's more universal claims
necessitate a more tightly controlled schema in order to be of use. Here, the generation of a
typology from a large set of data again places this research between the two approaches, at
once developing a typology in which there is little or no exception possible, while also
leaving room within such a typology for variation. That is, the wide applicability of a
typology (as a theoretical construct) can in this case provide both a strictness and openness to the coding process. In building types from the span of incidents present in the specific phenomena of MOOCs, these incidents can be seen in a more universal light.

What pushes this research away from both grounded theory and analytic induction, however, is the specific objection to any kind of natural attitude as being either desirable or wholly possible. That is, it is not possible to separate a foundation of tacit theoretical background from any research. After all, this is the lesson from both Heidegger (2010) and Derrida (2011) in response to Husserl's attempts toward the phenomenological *epoche*. As Michael Polanyi (1983) demonstrated, beyond just being a philosophically-demonstrable position, it is also a matter of practical effect as well.

Instead of bracketing off any theoretical influence from the process of analysis, the approach taken here is to engage this development of the particulars of the typology of critical incidents in a manner which approaches the question of types in an atheoretical fashion. However, while developed in an atheoretical fashion, the resulting typology serves an exemplary and illustrative function within a wider theoretical point of view. In this, instead of bracketing off a theoretical perspective in order to reach a “real” view of a phenomena, it is the phenomena which is bracketed off, given the abstracted form of a typology, and integrated with a wider theoretical perspective which is preserved. This follows an Althusserian (2005) rendering of the work of science in which empirical knowledge is is refined through a process of theoretical work. That is, the ultimate value of any empirical work is given in its theoretical alignment and development.

What emerges in this methodology is that the span of data is approached in not necessarily a naive sense, but in an unnamed fashion. The abstractions of the theoretical frame developed in the previous chapters engage the material of the forum data in order to understand the texture presented in the data, but this texture is not pre-given and is allowed to
develop from the ground up. That is, as developed in previous chapters and reflexively applied here, the theory is not applied to the data in order to determine the typology, but the data is “thought with” in a robust and situated fashion.

**Using Trace Data**

The analysis of what have been termed “trace data” (Geiger & Ribes, 2011), “electronic trace data” (Goggins, Mascaro, & Valetto, 2013), or “documents” (Østerlund, Sawyer, & Kaziunas, 2011) to understand behaviors in technological mediated spaces has been used in a number of areas. In many respects, despite its occasional presentation as a novelty, trace data falls in line with other modes of evidential analysis as is found in historical or organizational research (Østerlund et al., 2014). That is, electronic trace data are used toward the analysis of that which is both consciously and unconsciously left behind as users interact with a system as a means to reconstruct and understand events.

The method of trace data is especially evocative in the case of the present research, as it evokes a specific link to the philosophical position laid out by Derrida (1982a) in his consideration of *différance* and the deferral of trace which is central to the theoretical perspective described in previous chapters. The theoretical implications of this linkage, for methodological purposes, must be set aside for the moment, though the resonances that carry across from the previous chapters should not be forgotten. Particularly, the idea, central to Derrida, that the implications of any trace always exceed the present moment of the trace should be kept close at hand, especially when considering the implications of and relation between any traces. In this, the limited view immediately offered by the electronic traces should be understood to, in every case, reach outward and connect to a wider world of experience that, while only hinted at in the data itself, exerts a full measure of influence on the ways in which such traces are both formed and interpreted. This is a particularly relevant consideration given the kind of overarching experience produced through an engagement
with large sets of data as described in previous chapters. The relationship between large sets of user data and Derridean *différence* will be explicitly dealt with in chapter 7.

While some have argued that digital trace data alone is not robust enough to gain an ethnographic level of insight (Geiger & Ribes, 2011), the massive amount of forum data available from MOOCs provides a unique level of insight with the question of whether or not this is ethnographic research being immaterial for the purposes of this chapter. Across the three courses, 218,842 posts and comments spread over 46,916 threads were examined. Using a qualitative approach, it is possible to leverage such a volume of data toward a robust and interactive mode of insight. This volume allowed for the kind of theoretical saturation normally found in qualitative research (Eisenhardt, 1989) to be met early on in the analysis of each of the courses, with the following overflow of data providing both an analytic and an affective picture of the course as discussed in chapter 4.

Following the posts in the forum from start to finish in roughly chronological order, it was possible to experience the ebb and flow of the course—as it started with a sense of hopeful anticipation, the setting in of a sense of normalcy and the kind of familiarity that brings contempt (or at least the kind of assuredness that allows for unkind gripes and kind defense that follows), and then a sense of cathartic denouement, replete with promises of classmates to stay in touch and to never change. That is, the rhythm and tone of the course was able to be felt through the data alone. It was an unexpected and draining effect of reviewing the public forum data to find oneself embroiled in the miniature dramas of people's lives, their hopes and ambitions, and the basic solace that an online course seemed to offer to people otherwise outside of the normal environs of the academy.

In keeping within the ontological and epistemic frame developed in previous chapters, attending only to the trace data left behind in the wake of interactions rather than attempting any kind of humanistic mode of retrospective inquire allowed for a consideration of the
events of design without giving explicit privilege to an humanistic experience as would be
gathered via a version of ethnography (Garfinkel, 1967) or other qualitatively-founded
method such as interpretive phenomenological analysis (J. A. Smith & Osborn, 2008).
Turning away from any humanistic insight and focusing explicitly on trace data is not
without practical reason either. As will be seen in future subsections, the exclusive use of
trace data in developing the typology of critical incidents has important implications both
within the wider epistemic and ontological picture of this research as well as for the question
of methodological validity.

The Importance of the Method

For the present research, this particular methodological approach to the analysis of
trace data is important for the multi-level conversational analysis that it brings. By carefully
examining each piece of forum trace data (rather than subjecting it to a mode of automated
analysis, even only as initial step in the process), it becomes possible to draw connections
and linkages across the various discursive levels that are present in this kind of semantically-
rich data. Such an analysis brings together the meanings contained in the forum discourses,
ranging from the level of the individual words used, up through phrases, sentences, entire
posts, the threads, all the way to the forums themselves.

This labor-intensive mode of analysis allows for a highly interactive view into the
course forums and the types of incidents that develop within them. Being able to draw
connections across the entire spectrum of the data in an open fashion, it is possible to develop
a rich and semantically-embedded meaning as it is present across the totality of the forum
interactions. Through this “reading” of the forums and the distillation of a typology of critical
incidents that results, a dialectic engagement with the incidents is able to be understood: The
formal codes and the abstractions which they represent are given fulcrum against the totality
of the semantic background provided by the whole of the forum data, and vice versa.
Analysis

The analysis of the forum data was conducted after each course was completed. I was given access to the course data in the form of a MySQL database which logged the forums, threads, posts, and comments created over the course of the running of the MOOC, among other data related to the course. After identifying the tables in the database relevant to the course forums, a superficial survey of the kinds of information presented in the forums was conducted to ensure that it aligned with the expectations developed during the informal interviews.

In support of this qualitative analysis of a massive set of user data, a specialized database viewer was created in order to provide rapid and specific access to the tables and fields that were of interest. The viewer was designed to allow researchers to quickly page though the threaded forum data in chronological order according to when the initial post in a thread was created. For example, if both posts 1 and 2 were to start new threads and then post 3 were to post on thread created by post 1, researchers would view the posts in chronological order linked to the moment of the creation of the thread: post 1, post 3, post 2. While this did at times create a odd experience of the overall progression of the course (particularly in long and long-lived threads), this configuration allowed researchers to follow the progression of a thread a coherent and time-efficient manner. This kind of temporal interleaving produced, at times, a sense of foreshadowing when themes and issues developed later in the chronology of the course appeared in early threads.

Besides access to the text of posts and comments, the viewer also displayed a unique anonymized user id number corresponding to the author of each post, whether a post was posted anonymously or flagged for abuse, the time stamp of the post, and whether a thread featured an official response from the instructor or someone else associated with the university. All this was among other information relating to the id and relational structure of
the information in the database. The workflow of the system was set up so as to allow for two parallel coding systems (as will be detailed below) and two concurrent sets of notes which allowed for both specific and general reflections on the coding process. Table 1 provides an account of the number of posts etc. that were covered in the analysis.

<table>
<thead>
<tr>
<th>Course</th>
<th>Art</th>
<th>Maps</th>
<th>Energy</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>69,867</td>
<td>48,386</td>
<td>45,410</td>
<td>163,663</td>
</tr>
<tr>
<td>Active Students</td>
<td>47,967</td>
<td>36,257</td>
<td>22,144</td>
<td>106,368</td>
</tr>
<tr>
<td>Threads</td>
<td>8,198</td>
<td>13,080</td>
<td>25,638</td>
<td>46,916</td>
</tr>
<tr>
<td>Posts</td>
<td>29,876</td>
<td>69,486</td>
<td>56,225</td>
<td>155,587</td>
</tr>
<tr>
<td>Comments</td>
<td>22,292</td>
<td>28,161</td>
<td>12,802</td>
<td>63,255</td>
</tr>
<tr>
<td>Incidents Coded</td>
<td>688</td>
<td>676</td>
<td>383</td>
<td>1,747</td>
</tr>
<tr>
<td>Expressions Coded</td>
<td>447</td>
<td>216</td>
<td>65*</td>
<td>728</td>
</tr>
</tbody>
</table>

*The low number of expressions about the course in this case was affected by the structure of the course itself. Whereas in the other courses the coding of such expressions about the state of the course included both many spontaneous expressions of what they were learning and spontaneous sharing of external materials and resources, such expressions were part of the assigned forum activities in this course and as such were not included in coding.

Table 1: This table details the total numbers of registered students and the number of threads, posts, and comments made and a count of those that were coded. “Active students” refers to the number of students who accessed the course at least once. In total 218,842 posts and comments were reviewed.

**Coding Process**

Using the database viewer, the coding process started with a rough initial set of codes relating to the main novel characteristics of MOOCs (e.g. reliance on the Internet, scope, global distribution) and novel aspects relating to the challenge of designing MOOCs as derived from a review of existing discussions of MOOC development available online[^5] and informal interviews with instructors and designers involved with MOOCs. These initial codes established the basis for the final typology of critical incidents that was developed. A secondary set of codes focused on capturing information which related to students' attitudes (positive or negative), feedback, and suggestions about the course. These secondary codes served to chart attitudes about the course and mark those instances which, while not critical

[^5]: e.g. https://www.youtube.com/watch?v=JRFaup14dk
in the sense of a critical incident, nevertheless reflected important information about student attitudes. This second set of codes provided only informal reference in support of the main coding of critical incidents.

In coding the forum data, only those posts which related to either critical incidents in the course or presented a student's reaction to the course were coded. In considering critical incidents, only those aspects of the course unique to its format or online nature were coded. Other incidents which represented “traditional” student complaints (the fairness of a quiz question, for instance) were given a null code. Further, forum posts by students which represented either discussions that were germane to the topic of the course or a response to an assigned prompt from the instructor which required a forum post as part of an assignment were not coded. In these cases, the compulsory nature of the posts was seen as coloring the posts in a particular manner, adding static to an otherwise straightforward coding process. This was seen most directly in the Energy course where students were directly asked by the instructor to post about what they found most interesting in the week's assignment. This invariably led to many positive posts about the course which didn't add to the development of the typology.

In establishing codes, there was a concerted effort to code the data in such a way that, while referring specifically to the socio-technical phenomena of MOOCs, did not attempt to abstract any particular pedagogical strategies or features of the system that would only apply to educational settings. Codes relating to technical problems confronted in the process of testing and assignment submission are the exception here, though they may be considered more abstractly in other settings as applying to issues of users' execution and communication. Furthermore, while issues surrounding peer review in the Art course (and to a much lesser extent in the Maps course) proved an invaluable example of the central theme of coordination (discussed below), they were not included in the final coding schema since peer review was
not used to the same degree in all the courses studied. Instead, the analysis which resulted from a consideration of peer review will be utilized in order to explicate a more general central theme held in common among all the courses.

As described above, the sheer size of the data set available allowed a version of theoretical saturation (Eisenhardt, 1989) to be reached multiple times over the process of coding the data from a single course. This allowed for the iterative development of codes within the space of even a single course. The wealth of data available made it possible to develop the main typology, a system of sub-features, and the criteria for coding throughout the coding process and in a methodological and robust fashion.

Starting from a loose set of general codes and working chronologically, first with the Art course, followed by the Maps and Energy courses, review of the forum data quickly led to the expansion and reconfiguration of the initial set of codes, particularly as students new to both online learning and MOOCs had their first interactions with the course. Incidents surrounding these novice users offered the first stark example of the need to continually reconfigure and expand the coding schema in order that the codes could fit what was presented in the forum data.

For example, while the initial coding scheme projected that there would be critical incidents that were explicitly “technical” (a video not playing, a web page not loading, etc.), it soon became apparent that in many cases what at first appeared as a technical problem, was not a actually a problem in the intended function of the technology, but was instead a problem stemming from a users unfamiliarity with technological constructs that may be taken for granted by more experienced users. In the case of the Art course which required students to upload images of their artworks, by following the back and forth between students and course administrators, it became clear that many students who reported a technical problem (e.g. as one student described it, “I believe I’m following the correct process, but after I click
the Pic button and then click on the Pick File button, nothing is happening. I've tried a number of different things based on responses I've read here, but nothing seems to be working. I have my art image in my Photos File. Any help would be appreciated”) were simply unfamiliar with how to use the tools provided in the online course to select a file from their computer and upload it. In this case, a new code relating to “technical novelty” was added to the schema.

Another example of the progressive development of the coding schema can be found in the expansion of the “temporal” code. This was one of the initial codes developed based on the informal interviews and was applied to incidents which resulted from difficulties surrounding issues of the timing of the course. For a free, online course in which students from all walks of life from around the world need to follow a schedule of assignments and deadlines, problems stemming from the design of the timing and time management features of the course were common. Starting the coding however, it became evident that these temporal issues had either or both a specific character (students or the system confusing time zone conversions) and/or a general character (the overall timing of the course not fitting in with other aspects of their life (vacations, busy periods at work, etc.)). In this case, the existing temporal dimension of the coding schema was modified to include two sub codes corresponding to incidents that pointed either to specific temporal difficulties or more general issues surrounding the timing of the online course.

A more striking example of the iterative development of the coding schema for critical incidents came as it became clear that oftentimes incidents were not exclusive to a single code. A problem that may be temporal in its origin could also have cultural or geographical aspects and implications. As will be presented in more depth below, this realization led to the frequent application of multiple codes to a single incident. Unlike other changes to the coding schema, this development presented a starker alteration of the
formulation of the typology of critical incidents by which each type as originally and individually conceived was able to function as a dimensional characteristic of a more complex and dynamic type. With the potential for the application of multiple types to a single incident, it becomes possible to see how incidents may contain multiple aspects across different types as well as how incidents develop over time, with one type of incident initially characteristic of one type developing over time to more closely resemble another type. As will be discussed below, the use of a flexible and open coding system allowed for the possibility of the transformation of a staid and particulate approach to a typology to something that is more dynamic and more accurately represents the phenomena in question.

While the bulk of the data from the course forums was not explicitly coded, the data which corresponded to the “ordinary” (non-breakdown) activities of the online class nevertheless played an important role in supporting and sustaining the analysis of the coded data. This “ordinary” data scaffolded the existence of critical incidents, providing a window into the rhythms of the online course as it should be and laying out the surface of normalcy which is punctuated by the incidents. Besides providing a contrasting field against which critical incidents could be seen, in its volume, the mass of this data provided a certain mode of insight to the understanding of MOOCs akin (though certainly not identical) to that expected in ethnographic research. It offered a view into the lives of thousands of people, which, when taken in aggregate and pinned to the central shared fact of an online course, proved to demonstrate both the distance and immediacy that was able to be represented in the data.

**Verification and Validity**

In order to ensure the validity of the interpretation of the results presented here, I was largely guided by the seven interdependent recommendations for interpretivist research as laid out by Klein and Myers (1999). These principles lay out fundamental considerations for
ensuring the value of interpretive analysis of data. Starting from the fundamental principle of
the hermeneutic circle, the following six principles are contextualization, interaction,
abstraction and generalization, dialogic reasoning, multiple interpretations, and the principle
of suspicion.

The principles laid out by Klein and Myers prove to be, in large part, built into any
kind of trace data research as insights are drawn out from a wealth of mediating data. This is
particularly the case here as the ultimate identity of the subjects is masked by the kind of
anonymity offered by the Internet. Suspicion surrounding any statement being made in the
forums was necessarily the norm. While by virtue of their posting on the forums was enough
to prove their participation in the course (in this, they were not completely anonymous) and
the context for their comments, the claims made in the forum (particularly those regarding
deadlines, pleas for extensions, etc) needed to be treated carefully. As such, the course itself
provided a contextual fulcrum on which to leverage any interpretation of the data, with the
implications of any statements starting from how they fit into the flow of course as a whole
and then blossoming outward in any number of interpretations. As in the sections above,
these multiple spiraling interpretations were able to be contained by the abstracted forms the
massive volume of the data coalesced into. That is, through coding the data according to a
schema of critical incidents, the volume available allowed a consideration of the meaning of
individual statements in an abstracted form. This abstraction allowed individual statements to
coalesce around themes which reduced any reliance on individual statements. Even beyond
the data that was explicitly coded as representing students' feelings about a course or
representative of a critical incident, the rest of the bulk of the forum data relating to the
course topics themselves formed a similarly coherent picture when abstracted. In this, Klein
and Myers' seven principles served to systematically guide the the analysis, especially as
each individual case or statement only offered a thin slice of insight contextualized almost only by the student's presence in the course.

The validity of the process of interpretation was further helped by along by the ability to reflect on my own experiences in educational settings. This kind of reflexive consideration (Schultze, 2000, 2001) was the source for the initial judgments made in the initial coding process as to how best identify the aspects of the MOOC that related to the novel socio-technical form they represented and which incidents were simply symptoms of educational processes in general.

There was a built in coding check in the way in which the forums worked. By responding in the forums to some of the students' complaints but not others, the instructors and designers involved with a course provided a clue as to the validity of what should be considered a critical incident. Through their responses in the forums they validated the coding by responding to reports of incidents that they considered of legitimate concern, while ignoring those that were either non-sensible or clearly stemming from user confusion or those that pointed to issues beyond the scope of the course. That is, by virtue of viewing the forum data in a threaded fashion, it was possible to receive immediate insight into the kinds of incidents that were either significant or widespread enough to be considered critical in the eyes of those involved with the design of the course.

The Alignment of Method, Ontology, and Epistemology

Even beyond this kind of explicit verification, however, for this research, the sheer fact of an incident is seen to matter more in terms of its value than the recognition of it on the part of instructors or designers. No matter the reflection that the particular instructors or designers might have on an incident, by having robust documentation of a series of incidents that exemplify a type, there is proof enough of the occurrence (and re-occurrence) of a type to establish it. This is especially the case when similar incidents are able to be seen across
multiple courses. Whether or not the instructor/designer views these as critical incidents is immaterial in the wider view of the socio-technical amalgam that is in question here. If it can be shown to be of concern to users (especially multiple users in various “classroom” settings), it doesn’t matter if those who are (seemingly) in charge of the design of the course view the incident as important or not. The incidents still have an influence on the shaping and design of the course in the wider social setting in which they take place, even if they do not result in a traditionally “designed” response.

Following the overarching post-human epistemic and ontological position developed in previous chapters, this method focuses its claim of veridiction on the existent traces left in the forums, not a retrospective humanistic analysis. As such, the particular and (marginally) innovative approach to analytic induction as applied to a large set of trace data is one which is explicitly supported by the theoretical frame. The theory developed points to certain questions about the phenomena of design that can be answered in some ways that are epistemologically and ontologically aligned with certain methods and the kind of veridiction which they provide. Theoretically, what this research asks is what occurs in the field of action in the running of an online course that directs the design and re-design of the course and the socio-technical systems that surround it. The emphasis is on the historical occurrence of certain types of incidents in the running of the course. These incidents are best described through an analysis of the trace data found in the course forums as they mark the happening of design.

As described above, there remains healthy debate about the uses of trace data (Østerlund et al., 2014), what it is, and whether it was sufficient to use just trace data in order to get to the bottom of a phenomena or whether it is necessary to take a step beyond trace data and have that validated through some kind of more traditional method (like interviews). For this particular research, the theoretical frame is such that it is concerned with
the historical matrices of trace that develop over the running of a course. In this, it is methodologically concerned with a typological restructuring of these configurations, without concern for the broadly humanist appeal on which a call for a quasi-ethnographic method relies. That is, the broader theory supports a method which rigorously defines both what trace data is and distinguishes the insight of such traces from the insights derived from other methods.

**Results**

Through the analysis of 218,842 forum posts and comments, a pattern of distinct critical incidents became apparent. These incidents were signaled by users' posts which, in many cases, were then responded to by the course staff (with the promise of action or not). Posts relating to critical incidents were most frequent as students first engaged with the MOOC platform at the start of a course, and then at the end of the course, when special circumstances surrounding either final projects or exams highlighted points of stress in the system.

The intensive process of coding 218,842 posts across three courses led to an amazingly rich experience of the ebbs and flows of each of the courses. What becomes apparent quickly in any analysis of this scale of forum data for a MOOC is the range of absolutely unique circumstances each student finds themselves in, and the varied and singular reasons each student has for taking a particular course. Most striking is the level of human pathos that is able to be recognized across the mass of forum posts of the 106,368 student who were in some way active the courses. In every course, students' personal lives, hardships, joys, and wishes for the future were clearly evident, all of which implicated how they related to the course. This was startling in the Art course as many students' expressed a life-long dream of being an artist that was left unfulfilled or eclipsed by other necessities of life. In the Maps course there was a palpable sense of hope for some students who were
seeking GIS skills to make them more employable. The Energy course overflowed with either pride or guilt around students’ efforts to do as little harm to the environment as possible. Through this an engagement with such a large set of data, it became possible to gain a sense of both the variety of experiences that brought students to the particular courses and the individual position from which each student approached each course.

Through just the forum data, it was possible to understand the rhythms each course produced. Through the analysis of the course data it was possible to gain a sense of the nascent anticipation present at the start of a course, the humdrum regularity of the middle once students were acclimated to the course, and then the sense of both melancholy and relief at the completion of the course. These kinds of impressions were not built from the appreciation of a single data point, but were established over the span of the data. That is, the forum data allows for an overarching experience of the course, as *Erfahrung*, even as what is given in the forum is only the keyhole view given by each individual poster. In analyzing student comments about the course and the kind of back and forth that exists between students and instructors, it is possible to see understand the jockeying back and forth as each work out what the course is meant to mean in a rich and quasi-ethnographic way.

**Developing a Typology of Critical Incidents**

Through a process of iterative coding of the forum data, a typology of critical incidents in MOOCs was developed. At bottom, each type of event represents a specific variety of a breakdown in the coordination of intelligibility across both human and non-human actors through which the space of the work of design is led forward. These incidents are both singular incidents and situations faced by a number of students, extended across a period of time. While many unique problems and challenges were faced only in individual courses, these types represent classes of problems that were faced across all courses and that were able to be abstracted into recognizable types.
This typology focuses on the particular incidents related to MOOCs, avoiding issues shared in common with traditional form of education (questions about grading, unfair quiz questions etc.), unless those problems demonstrate a particular difficulty because of their connection to an online course. That is, it focuses on those aspects that distinguish (either quantitatively or qualitatively) MOOCs from other, more traditional forms of education. Of course, some overlap of incidents with other modes of traditional and online education does exist, with this overlap included because of the special framing or character given to such incidents due to the scale or distributed nature of the courses.

In identifying critical incidents, it needs to be emphasized that due to the temporally-distributed nature of each students’ engagement with the course, these incidents, while they may represent an eventful occurrence in the work of the continued design of the socio-technical system, are not necessarily discreet incidents in terms of being temporally-located at a single moment, but instead may arise over a longer span. The implications that this temporal and scalar distension has on identifying critical incidents will be further discussed in the sections which follow.

The typology developed is comprised of six interlocking types which are comprised of twenty sub types. The six general types provide abstracted description of the types of incidents; the subtypes point to the actual kind of incident that is seen in the course data:

**Technical:** These types of incidents focus on problems which arise with the material configuration of the technology that delivers the course. Besides the general type, there are four sub-types:

**Typo:** This is the most basic sub type which focuses on small, easily corrected errors, either in the text of the lessons or a careless misconfiguration of links.
**Testing/Assignments:** These are errors that relate to the infrastructure specifically surrounding quizzes and tests. While this may include something like a typo, it mainly refers to the set of problems which surround recording and grading students' performance.

**Compatibility:** These are technical errors that are associated with an incompatibility between the course platform and the particular web browser or platform chosen by users.

**Account:** These are incidents in which the technical infrastructure fails due to problems associated with students' ability to access their accounts.

**Novel:** These types of incidents correspond to events precipitated by users' unfamiliarity with MOOCs, online education, and more generally the technologies on which they rely. Besides the general type, there are four sub-types:

- **Technical:** These incidents are those in which a user encounters a specific technical problem that is the result of their unfamiliarity with the technologies used in the course.

- **Platform:** These are incidents which result from an unfamiliarity with the Coursera platform which supports the MOOCs studied.

- **Course:** These incidents occur when novel MOOC course policies, pedagogical methods, or requirements cause confusion for students.

- **Public:** With MOOCs, there is a specific novelty to the fact that, due to their size and open nature, the course (and what goes on in the course) is largely public.

**Cultural:** These incidents represent events which focus on the differences in language and moral and legal frameworks that are particular to the individuals taking a course. Care needs to be taken to differentiate these from purely geographical incidents. Besides the main type, there are three sub-types:
Legal: These incidents are those which arise from the ideologically-imputed adherence to an assumed legal framework. They are different from geographically-imposed legal restrictions in that they are not enforced outside of an individual's semi-tacit adherence or questioning about their need to adhere to a certain legal tenet.

Language: For courses offered to a global audience, language differences are a frequent question. These incidents are displayed in a positive fashion through students forming study groups for other speakers of their native language, and negatively through both the kinds of misunderstandings that can arise, as well as more startling examples of linguistic prejudice.

Moral: Broadly construed as pertaining to the sets of values, morals, and ethics that students bring to the course, these incidents surround the question of what is correct action.

Scalar: These are incidents which result from the outsized scale of MOOCs. They are both issues that are directly related to the size of the course as well as other issues that develop because of that scale. Beside the main type, there are four sub-types that stem from the scale of the system:

Discussion: Given the number of students posting to the forums and the frequent requirement that students post and respond to other posts on the forums, the sheer scale of the course provokes incidents in which students are overwhelmed by the volume of discussion presented in the forums.

Diversity: With the large scale of the course comes an increased chance for the personal and sometimes idiosyncratic details of students' lives to have an impact on their use of the course.

Skill Level: As MOOCs are open to anyone who wishes to register, students come to the courses with a wide variety of skill levels which can instigate incidents, both
for students who struggle with the course as well as those who feel dragged down by those who come to the course will a lower level of skill or knowledge about a topic.

**Bad Actors:** As with incidents that stem from the diverse range of human experiences that are possible within a course, the scale and openness of MOOCs also allows for incidents involving a range of bad actors, including spammers, bullies, and cheaters.

**Geographical:** These are incidents that are immediately dependent on the local conditions of a globally-distributed user-base. There are three sub-types:

- **Bandwidth:** Having a range of users from around the globe, many experience issues with being able to adequately access course materials, either because of intermittent access to an Internet connection or because of a slow connection unable to handle the sometimes data-heavy requirements of an online course.

- **Restriction:** These incidents occur when, for either political or licensing reasons, certain components of a course (mostly video) are not available in certain regions or nations.

- **Local/Global:** These novel incidents occur when local conditions such as weather, power outages, or other kinds of localized occurrences prevent students from participating in a course. In these cases, local events can be seen to have global (if only personal) implications.

**Temporal:** These are incidents that are caused by the unique temporal conditions faced in a MOOC as it is used for a fixed period of time by students from around the globe. There are two sub-types of temporal incidents:

- **General:** Given that MOOCs are open to anyone and (in the case of the courses studied) free to take, there are unique incidents caused when the general timing of the course conflicts with students' schedules outside of the course. These come in the
form of students missing the start of the course or not being able to fit course schedule into their lives.

**Specific**: Specific instances of the timing of a course relate mainly to problems encountered as students from around the globe, many of whom are working in vastly different time zones, attempt to coordinate their work with the deadlines given by the course.

What each of these types and sub types illustrate and give name to are the conditions faced in the design and deployment of MOOCs. The six main types of critical incidents reflect abstract features that are unique to MOOCs and other large-scale technical system, while the sub-types point more directly to actual incidents related to these broader characteristics.

Table 2 provides example comments from students drawn from forum posts in each of the three courses corresponding to each type and sub type represented in the typology.

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<tr>
<td>Technical</td>
<td>I've tried three different computers and every time I try to submit my work, I get past the first home screen but then the second screen with the three little boxes (for submission, evaluation and results) is frozen. I cannot submit my work and am very frustrated.</td>
<td>Good Grief! EVERYTHING takes SO long to LOAD up! I'm getting errors on most tasks. Sorry but I'm losing interest since I can't effectively accomplish anything - I may keep playing with this because it is COOL stuff. However, I'm frustrated with ARC GIS AND your forum and I doubt I'll be able to take the test since I can't &quot;DO&quot; the lessons! Any advice?</td>
<td>Discussion Forums isn't working. It just keeps &quot;loading&quot; and &quot;loading....&quot;, I have waited for a longtime and it doesn't appear to work.</td>
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<td>Typo</td>
<td>The text describing the assignment for Inside the Space is a copy of the text for Through the Lens (and thus inappropriate). I saw this on the submission page, but have also seen it in other assignments. Copy editing is hard to do, but mistakes are easy to see!</td>
<td>Actually, I noticed that the deadline on the syllabus doesn't match the deadline listed on the Quiz page (a day later), but the quiz page, once you submit your quiz docks the late penalty based on the syllabus deadline (which is a day earlier). I went ahead and applied a late penalty.</td>
<td>I really appreciate these videos! That is why I would like to report a general problem. As English is not my mother tongue, I sometimes put on the English Automatic Captions, so I was astonished to find out numerous mistakes in the captions which couple [the instructor's] videos. As I listened to the videos while watching them, it was not a big problem for me, but I think...</td>
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<td>Testing / Assignments</td>
<td>I would like to do the quiz but I can't answer the questions 7, 8, 9, 10 because I can't see the paintings. How can I do</td>
<td>Submitted quiz, got result back. Every single checked answer in the review is different than what I answered. Checks are in the same position (I think) but questions underneath have been rotated. Naturally most answers are now wrong. I think this might have to do with the noise I have on my rural DSL line. I clicked submit and got an error (Web Page not Available). I clicked the back arrow, then submit and it went, was graded and was all wrong. specs: Windows 7 Pro 64 bit, Google Chrome, DSL internet connection (Cat5e, not wireless), AMD 3.2 GHz, 4 Gb RAM. This has not happened in the other course I am doing, but every thing in this course seems to take a very very long time. Even a click on the map is a second or so delay before I get the popup window.</td>
<td>I just completed the quiz. I had 2 answers wrong. The first one, which is an obvious one, I had checked the correct answer but the system showed another answer!!! I am pretty sure I picked the right answer. (The second question I had wrong, the system correctly identified my mistake.) Could you please ensure that your system records correctly the answers that we choose.</td>
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<tr>
<td>Compatibility</td>
<td>I have tried to copy and paste my artist statement several times. Each time, I get the message &quot;Your browser does not support...&quot; I am using Chrome. Message also says to use the browser keys. Is it possible to copy and paste from a word document to the statement page to upload??</td>
<td>It would be useful to the newbie user to have listed basic hardware and software requirements for using ArcGIS ONLINE. This would be useful info before signing up for the course, and also within the context of this course. For example, at the moment I am using an iPad to view the course from a comfortable chair. The course materials seem to work fine, but the first interaction asks me to tag my location on a map. The interactive map comes up, but doesn't play.</td>
<td>Please note that there are currently issues with viewing issues using both Safari 6 and Safari 7. The error results in you not being able to see the video, but can hear the audio. Coursera is aware of this issue and is working on a solution. In the meanwhile, as an alternative solution, you can try to download the Video Lectures using the Video Lecture link on the right side of the page. We will update you as soon as we have a solution.</td>
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<td>nice on my iPad. Reading the forums, it seems that ArcGIS works presently only on Windows. I will have to get on my Mac and fire up Virtual Box to run Windows XP to see if that will allow me to interact with ESRI ArcGIS Online Maps.</td>
<td>I can not sign in to ArcGIS on-line... I fill all the spaces correctly and at the end it just say: An error occur when trying to create your account. I have tried many times with different option and it always gives the same error...</td>
<td>I was using my previous school email for this class but that email has been deactivated. My new email is [. . . ] Any help is very much appreciated in what I need to do</td>
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<td>I jus had to create a new e-mail address as I can not have access to the prior one. Assignments W1 to W5 were done on the former address Assignment W6 has just been completed on new address On completion of the course, how will all the assignments be taken into account</td>
<td>Is it OK if I just read the text and watch only the video assignment instead of watching all the videos (to save bandwidth) ? ...the intro video said that it can be done, but I am still wondering if that's a smart thing to do</td>
<td>I do not know how to post a picture to the activity forum. I could post a link to a picture, but that wouldn't be easily accessible. Also, some of the pictures I saw posted didn't have any attributions as to where they originated. Is that O.K. -- I didn't think so. Help this septuagenarian with the technical info for posting a picture to fulfill the activity requirement. Thanks</td>
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<td>This is my first time taking an internet class. I am finding it difficult to follow the steps in the process. Does one go to the &quot;Weekly Lessons&quot; link, or assignment due dates, or assignment details? Is the first week about the fantasy art, or is that something different? I am in the process of listening to/watching the video lectures. When I finish those, what do I do next? Thank you for any help you can give me. I guess I need a step-by-step road map, just like the kind I give the students I teach! And I teach elementary school! p.s. What is a &quot;bug&quot; report?</td>
<td>I had trouble placing my pin on the map; not sure if it really took my pin and information. How can I tell if I am represented on the map?</td>
<td>I am trying to complete assignment one on Energy -- I saved a sharable image from Flikr (as suggested) to my desktop using save link as. When I tried to add it to the new thread area I received the error message &quot;sorry we do not accept HTML&quot; I guess I only saved the location and not the picture. I have no idea how to save the picture so I can share it. I am not tech savvy so if you have an idea how to do this properly can you provide step by step instructions.</td>
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<td>I am a total novice at uploading pictures. I know how to use Picasa to get them from my camera to my computer but I have no idea what to do from there. What is supposed to happen after I click the Pic icon at the top? Do I send my pic from my camera or from my computer? I have played around but I really need step by step instructions.</td>
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**Platform**

I don't know how to submit my work, once I have it ready and photographed where do I go? , what do I do? Please help!

The ArcGIS map has lots of information and capabilities. [Instructor], can you recommend any resources that walk you through them systematically?

I don't understand the points that are listed by people's posts. Is that the number of points a student receives for the post? Do we have to do a certain number of posts or comments to get the maximum points for a lesson? Perhaps most people know how this works but I am 71 years old and struggle with the use of these new technologies.

**Course**

while taking the quizzes, can i go back to the reading materials or videos to find answers? or the quizzes meant to be taken like a "closed book" exam

Hello, I was wondering of this course is only available for the 5 weeks it is set to run for. I'm going on holiday half way through the course but would like to complete it when I get back if possible

Grading seems complicated: not sure I understand...

**Public**

I have evaluated 7. Two of them I like so much I would have them as prints on my wall at home. It is apparent to me that I have no talent for art. I really like my own art but after this course I will never make anyone look at any of my art, and I apologize now for insisting on submitting my art for this course so some poor person has to evaluate it. But thanks for your tolerance! :-)

I was struck that [instructor] posted a photo of his daughter, along with her location, on a publicly accessible map. Many might say that posting such information is inviting trouble. I don't know that I agree, but it should be considered. Likewise some commentators have suggested that making your location available at all times might invite trouble. The argument is that thieves can know when your home, or not at home, thus informing them of open windows of opportunity. Is instantly available spatial information about potentially everyone a good thing?

When I go to FB to take the Energy Hog quiz, it alerts me that it wants permission to access my profile, city, and friends list.Profile and city - that's OK, however I do not see the point in releasing my friends list to the page. That's too much info to hand over, especially since my friends are not taking the course. Can this be changed?

**Cultural**

I'm sorry but some people become offended when you call the Bible a "Myth". Could I also point out it is the Big Bang Theory, not the Big Bang.

While watching the video lectures, I had a feeling of participating i a quite ethnocentric styled course. First, talking about mobile devices and people using them for navigation, location based services and so fourth, it seems to be totally left out

You pretty much hit the nail on the head. If you have been reading the content in the course and watching the videos, you probably noticed that a lot of it is US-centric. Trying to create a course that contained content from every country represented was not possible for us.&nbsp; Our strategy was to provide the US view (since that is
that most of the people living on earth don’t have access to these technologies. Second, I was disappointed by the "Hollywood" styled video lecture that talks about LBS’s in the beginning and then switching pathetically to Haiti. Framing the catastrophe and the sorrow issue like only technology from white people helps "those poor people" there seems to be a superficial and undifferentiated view on a very complex issue. Both are examples of an exclusively ‘western’ perspective, or even a North American one. Your thoughts?

Legal

Do we retain all legal rights to our original work if we share it here?

It would seem that the ArcGIS “Terms of Service” creates a dilemma for users. Either we accept the agreement without really understanding it, or we spend several hours in examining the details of the agreement. The agreement is around 1500 lines long and contains references to more than 90 links! Is clicking "I Accept" really a reasonable action?

Kindly remove the post of [other student] because he may not be aware of the possibility of copyright infringement when he posted a comment in toto from http://climateethicscampaign.org without adding his own comment and without attribution. I tried to alert him and [other student] did so, too. [The other student] may not catch his error right away,

Language

I am sorry for my English, translated from English to Translito.co

Hola a todos. alguien ,me puede indicar como puedo descargar los subtítulos de los videos....

I refer to your comment at the beginning of Lesson 9: "Don’t even think about going to the bathroom in your neighbor’s driveway." You have a lot of international non-
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<td>Moral</td>
<td>Please respect the fact that there are women - and children - taking this course and keep your comments respectful. We are not 'chicks'. The point of drawing life models is not to 'get chicks stripped'. I'm sure you didn't mean to be offensive</td>
<td>I actually thought it was a bit weird for [the instructor] to show the picture of his crying baby along with his home address, but now I understand this was probably done on purpose to boost the discussion on geospatial privacy (is that a real term?)</td>
<td>Imagine how much energy all the course participants are using to enjoy this discussion about Energy, the Environment, and Our Future. It's a bit hypocritical, don't you think? We often forget that almost every human activity consumes energy, and that all forms of energy have some adverse effects. We also forget that energy use has a temporal aspect, as we all benefit from generations of investment in energy infrastructure. We would not be the people we are, or live in the societies we do, without substantial consumption of energy over hundreds of years. That's a difficult legacy to erase. More importantly, do we have the right to deny others the same access to energy from which we all benefitted?</td>
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<td>Scalar</td>
<td>The way I see it, the biggest problem we have is not a problem with the course per se, but a problem that when you get 50,000+ people together, you inevitably end up with quite a lot of whining and attention-seeking behavior in the forums as well as a lot of unnecessary posts from people who didn't bother to read the instructions carefully asking questions that were already answered in the instructions. This clogs up the forums with a lot of garbage that has little educational value and makes the content that is valuable more difficult to find. It's a signal-to-noise ratio problem. This is something I have seen in other Coursera courses, although it has been quite pronounced in this</td>
<td>With thousands of us participating by decree, the true usefulness of online discussion is liable to be drowned in the sheer numbers of participants. At least, the graded posts are restricted to the discussion assignment areas.</td>
<td>I fully agree, I felt so overwhelmed when I first opened the discussion board... I can be compulsive; I do not have the time for such behavior, I need focused learning. I am in an Emergency Management class now, multitasking - so I can cover my areas</td>
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Hi [. . .] - please don't be discouraged by the range of ability and experience of the students in this course. I don't consider myself to have any talent either, but I do aim to improve my technique and it's important for me to have other similar people on the course, like you! Solidarity for the Quiz 2 asked what a map scale was. May I politely suggest if you don't know that then maybe the course isn't for you? I really do not see the point in such a question (especially in week 2). I know this is a beginners but even us beginners know what a scale and Please be realistic, I enjoy education but......if the experts in their perspective fields, or the public and private sectors cannot implement a feasible plan/portfolio activity for the United States how can I possibly be expected to provide an intelligent well thought out portfolio? This class has provided an abundance of information however the
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<td>untalented!</td>
<td>what it is for!</td>
<td>requirements to obtain a simple certificate of accomplishment are overkill. I am not opposed to hard work but for these requirements I would have enrolled in a local university or community college to earn credit for a course with this much work. I do applaud the professors and staff for such an enthusiastic commitment to education. They serve as an example of the type of instructors we need more of in not only a university setting but in grades 1-12. Lets all do our part to reduce our use/abuse of all forms of energy. Make conscience decisions daily and stop relying on someone else for the answers.</td>
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<td>Bad Actors</td>
<td>I responded to someone in this thread commenting on cultural differences in communication and how sometimes this can lead to misunderstandings. Because I got into a disagreement on another thread and complained that English speakers insist on politeness and non rudeness and I commented my culture is more direct and honest I am now being bullied aggressively and accused of racism, this is quite a violent verbal attack four hours after the conversation has ended. The only purpose of this post is to be hostile and aggressive towards me. I ask staff to ask people to stop attacking [ . . . ] and stop making comments and responses to any of her posts that they take a dislike to. I am really upset to be attacked and bullied by bystanders to an a meaningful exchange I was having with [ . . . ]. I am over again accused on another thread of being rude and insulting but I have not called anyone a name or sworn at anyone or said their opinion was unacceptable to</td>
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<td>Using a language other than English is not an attitude that facilitates both the discussion, main objective of this Forum from my point of view, or a clear understanding by all participants</td>
<td>ARE YOU PEOPLE GENUINE? APPEARS NOT, BECAUSE YOU ALLOW THIS KIND OF SHIT POSTED BY PSYCHOLOGICALLY DISORDERED LOSERS TO PERMEATE YOUR DISCUSSION BOARD FROM DAY ONE AND DO NOTHING ABOUT IT.</td>
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<tr>
<td>Geographical</td>
<td>I've been trying to get newspaper for my next assignment but where I am there isn't much in the way of black and white newsprint. Most is colored, and the only blacks i've seen are the PRINT itself :/ Anyone else having a problem with this?</td>
<td>Following our Mapping assignments using the wonderful ARC-GIS, I have to ask it out loud: How come there are almost no layers to be found that actually cover Canada (even, just Toronto)? And I found exactly one(1!!!) that got closer to the level of detail we had with the US tapestry layer. Is it me performing the wrong search? or maybe there's another, more Canadian-friendly, GIS out there? Or is Canada just behind the time on GIS (which, I'm sorry to say, would not surprise me)</td>
<td>If anyone would like to have a new sub-forum created for a study group, a country, state, city, a particular focus, etc., please request it here. We are happy to set them up if it will help you all connect!</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>Hi all, I am so interested in art. I live in Myanmar, internet connection is poor. Please send the Teacher's Guide Video File to my email. I would like to learn more detail</td>
<td>could you reduce the size of the videos? I live in a developing country with slow internet speeds. Trying to download or stream a 5 min. video of 300 mb size is difficult. When I've taken other coursera courses, the videos for 5 mins. are around 20 mb so I know that it can be done.</td>
<td>Thanks to the instructor for the reply and I also would like to follow the idea of [other student] for the importance of getting pdf or ppt format of the course. For us in Madagascar, we have connection problem and we prefer to download the lesson when the opportunity exist and read them after. Staying connected for a long time is not possible for us.</td>
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<td>Restriction</td>
<td>i cannot view about the course videos as you tube is inaccessible in my country pakistan. what can be done plz?</td>
<td>Unfortunately access to ArcGIS Online is forbidden for certain countries, I wonder whether there can be an exception for students of those countries that are taking this cours</td>
<td>As of a few days ago, students in Cuba, Iran and Sudan are now being blocked from accessing Coursera classes, which have been classified as a service under the U.S. sanctions against those countries (an exception has been made in the case of Syria). Please sign this petition to the White House to reverse the policy, and encourage your fellow learners to do the same (Note: to sign the petition you must first create an account at <a href="https://petitions.whitehouse.gov">https://petitions.whitehouse.gov</a>,</td>
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<tr>
<td>TYPE</td>
<td>ART</td>
<td>MAPS</td>
<td>ENERGY</td>
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<tr>
<td>Local / Global</td>
<td>Egypt is currently in a political revolutionary state... I couldn't work on the Inside the Space assignment due to the fact there was protests going on and political turmoil. So I just answered the quiz. My question is do I have to do both or i can choose?</td>
<td>My apologies but I am unable to complete the course at this time. My work in Afghanistan has heated up with several deadlines, security concerns and a kidnapping to address. I have enjoyed it but simply cannot finish between now and the submission deadlines. Hopefully I will have a chance to complete the last assignments at some point. Thank you for your time.</td>
<td>Good Day! I really would love to finish this course but I cannot due to circumstances I cannot control. First, because of the series of low pressure areas that has been affecting this place of the Philippines where I am staying, we have been having internet connection problems. The wifi signal was not restored until today and in as much as I would want to cope with everything that I have missed, that would not be possible anymore because I am in the middle of a task force involvement (equipment acquisition for the whole university system that I am connected with currently), which would require much of my time for the remaining semester. That is on top of the fact that the final exams are now almost upon us, which would also mean grade computations, checking of requirements and 13 research proposals, removal exams, etc. This would leave me with no choice but to un-enroll but before I do that, I want to know if I can still enroll the next time this course opens. I would also like to ask when the re-opening would be. Would you be reopening within March? Our task force work will not over until next year because of glitches that we have encountered but March is the beginning of our summer break so I am sure I can finish the course. I really love the course. I have learned a lot and can actually take the quizzes but I cannot find the time to work on the assignments just yet, and I want to finish this course without missing anything.</td>
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<tr>
<td>Temporal</td>
<td>I began this course intending to do all the work including the art work. I do not have a lot of free time, but the time estimates for the class</td>
<td>The deadlines you set in syllabus are very tight, considering it is summer and people might go on even a two-week vacation.</td>
<td>Good Morning! Sorry for the delay, I have just gotten back into work and found the email regarding the posts being due Wednesday. I apologize for the delay. I am a</td>
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which I believe requires a U.S. address): https://petitions.whitehouse.gov/petition/reverse-policy-which-prohibits-massive-open-online-courses...
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<th>ART</th>
<th>MAPS</th>
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<td></td>
<td>seemed possible. I planned a collage for my introduction but did not get to make it. I did not attempt the fantasy art assignment because it didn't really interest me. Mail art interested me quite a bit. I got an idea which I really liked and got well along in it but was not able to meet the deadline. Fortunately, I see that I can post it in the Mail Art forum (if I can figure out how to do that) so I will try to complete it tomorrow and do that. But to come up with an idea, search for collage images, cut them out, make an envelope and an insert, glue the images on, add painting or drawing to the work, photograph it and submit it, all in two hours?? Am I just slow or are others finding that these assignments take a lot longer than the estimated time?</td>
<td>Could you give us some more time to watch the videos and do the homework? Peer assessed things I understand can't be done if things are too stretched, but maybe this course mustn't be completed in one month. This isn't a real-word university where we have to earn grades in tight schedule, nothing else builds on this course.</td>
<td>teacher and have just come off of our Winter Break and did not notice the due dates until I had seen the email this morning about the discussion being due yesterday. Will I be able to have grace for this first thread and continue with the class to receive a statement of accomplishment? Please let me know. Thank you. Thank you again, I greatly appreciate your consideration.</td>
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| General | When are the quizzes available? Some of the quizzes I would like to do a day or two before the deadline because I will be travelling on the due dat | I was wondering of this course is only available for the 5 weeks it is set to run for. I'm going on holiday half way through the course but would like to complete it when I get back if possible | Most of us who participate in online courses work full-time plus have other responsibilities on top of that. Therefore, requirement of weekly forum engagement and weekly deadlines, for example, becomes too intense and demanding. I could suggest the format from another course where the entire quiz and assignments were all lumped together with the same deadline at the end of the course. The final exam was scheduled just days after the quizzes. It was really excellent and gave the right flexibility to study the subjects even with a busy schedule. It also offered late signees a chance to catch up. |

| Specific | It is 11:04pm my time and I went to enter my assignment and it said I was too late. Then I noticed some universal time. I have taken several courses and have never had to use some other time zone other than my own. This is extremely | I was trying to submit the quiz for Lesson 1, and just realised that due to confusion with the time zones just missed the hard deadline. Of course it is completely my fault that I was not attentive enough with the difference in | So I'm not exactly sure where to post this, but I just noticed that everything was due GMT time; I'm in PST. I guess I thought everything was due EST since the class is based out of [name of university]. I think I have been submitting all my assignments late. Is there a way I can check on my |
Table 2: This table provides examples of the types and sub-types of critical incidents as they were represented in forum posts across the three courses studied.

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<th>TYPE</th>
<th>ART</th>
<th>MAPS</th>
<th>ENERGY</th>
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<tr>
<td>upsetting that no one will be evaluating or seeing my labored work!!! You do not play nice.</td>
<td>times. However I would like to ask you to let me submit this quiz. I am extremely interested in the course and I am very willing to continue it. I will be very grateful if you could do this favour to me just this one time.</td>
<td>points? Will I still receive points? Thanks</td>
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Types as Characteristics

In developing this typology of critical incidents, it became apparent that in many cases individual incidents came to represent multiple types. In these cases, real incidents are not confined to a single type, but rely on a mix of several different types, with each incident offering its own unique admixture of several types. This overdetermination of individual incidents necessitated a consideration of how to understand the interaction of different types interior to a single incident.

For example, incidents in which students experienced difficulty with some novel aspect of the course (regarding assignment deadlines, for instance) also frequently demonstrated temporal characteristics as well; confusion surrounding why an open online course would have strict deadlines (the question of the novelty of the organization of the course) quickly spiraled to become an issue about a missed deadline. In other examples, technical problems (either on the part of the user or the course platform itself) similarly spiraled into temporal issues as students were unable to complete assignments within the allotted timeframe. Difficulties with language coincided with a simultaneous limitation on the kinds of resources that could be accessed due to geographical and political restrictions. Such overdetermination of critical incidents and the varying degrees to which different types contributed to the severity of an incident are able to be conceptualized in the form of a radar
chart which illustrates the particular conceptual space that each incident carves out. Several examples are shown in figures 1-8.

Figure 1. Example illustration of a critical incident: “Due to some family troubles, I am behind this week. I wanted to catch up with week 3 lessons, but I keep getting the following message: System Error We are sorry, but an error has occurred and the details of the error message is below. If this error message persists, please contact a system administrator for more details.”
Figure 2. Example illustration of a critical incident: “hello (excuse my english) so, I just dont know where i go, or what to do to submit my work, i have finished it but, I dont know where to upload, where is the button? hahaha I AM LOST, HELP excuse my english, is very poor, and thank you.”
Figure 3. Example illustration of a critical incident: “I am a life long learner needless to list my credentials it is not important anymore... I am 62 years old mother of two adult daughters. In a few years I will retire. As a child I always liked Art and never had an opportunity to study. This is the first time I am taking a course on line and am confused with this discussion groups, assignments, deadlines and the process of postings. Could someone guide me an easy way to access the students art projects that are being produced due to the course? I love to see how others are interpreting these projects otherwise I am trying to find a needle in a haystack. I don't have time to sift through with everyone's comments, threads or posts. Please help.”
Figure 4. Example illustration of a critical incident: “Hello, I'm new here, and I hope I'm posting in the right thread and I hope someone will clarify my doubt. This is my first time in the course, I was going to sign up for the may classes (because that was the only option available at the time) and It said I could start now(?) and yeah, here I am. My question is, how can I take part of the course if it's already begun? Is this a mistake, me being here? I'm sorry If I don't make myself understand, english is not my mother tongue and I hope I'm not offending anyone with this thread. Sorry and thanks”
Figure 5. Example illustration of a critical incident: “This person's attitude is unfair to the greater body of students, and may even be trolling. She condemns English speakers for being appalled at her brutal honesty, which she claims is her culture. I feel she is being disrespectful to the many other peoples and cultures on this course. Sorry to bother you with this, but there is something unsettling about this students continual attacks on English speakers and their culture.”
Figure 6. Example illustration of a critical incident: “just to make it more complicated, the first three weeks of the course coincided with the last three weeks of my time in a rural Nepal district - where internet was either very slow or non existent - made some of the course particularly tricky - back in Melbourne now and ready to catch up (I hope)”
Figure 7. Example illustration of a critical incident: “Hi, due to internet problems in my home town (‘s-Hertogenbosch, the Netherlands) I was unable to send in the Quiz of lesson 1 on time. Therefore I was a half day late to submit them. Can you still accept and honor my submission? Also, I started the course later than the starting date, due to vacation...”
What is important to remember here is that not all incidents were the result of such overdetermination. Many were straightforward and based only on a single type. Nevertheless, a significant number of incidents do represent this kind of mixture, presenting themselves as a kind of molecular form derived from the basic atomic building blocks of types.

Not meant to be a quantitative representation of these qualitatively-defined types, this kind of representation illustrates the particular figure cut by each unique incident simply as an abstraction of the kinds of valences that are possible across the critical incidents which drive the design of MOOCs. These abstractions give shape to the spaces opened up by these events in the courses which allow for the future social and technical reconfigurations that characterize the design of a socio-technical system. These shapes trace out the constellation of effect and effectivities across the entire of the socio-techical system that develops.
Three Themes

In developing this typology of critical incidents, several cross-cutting themes were able to be noticed across incidents and types. These themes contribute to the function of the typology and provided support for understanding the function of such incidents within the overall milieu in which they developed. Here, three of those themes will be explored.

The Theme of the Coordination of Intelligibility

In sketching out this typology of critical incidents, one common theme that cuts across all the various types of incidents and serves as a source of their importance is a concern with the coordination of intelligibility. This sense of intelligibility is not just concerned with the human intelligibility of the system, but also with the technical and material coordinations that were seen as being necessary for the function of a course. Critical incidents could be seen both in the breakdown of such coordination and in the founding of new modes of shared intelligibility. This coordination could be something as simple as ensuring that a hyperlink pointed to the right web page to something as complex as establishing appropriate cross-cultural understandings for what was considered appropriate critique in a peer review.

This question of the coordination of intelligibility and the kinds of breakdowns illustrated in critical incidents follows a Heideggerian (2010) rendering of the breakdown in tool use frequently used in the analysis of design (Winograd & Flores, 1986). As detailed in previous chapters, in explicating the kind of division between activities which are present-at-hand versus those that are ready-to-hand, Heidegger laid out an illustration of the ontological distinction between the kinds of activities that progress smoothly without concern and those that, in their unexpectedness and the breakdown in intelligibility that they bring, call our attention toward them. The classic example in this regard is that of the hammer that to the cobbler appears almost invisible in the process of their work up (ready-to-hand), that is, up
until the moment that the hammer breaks. When the hammer breaks (the breakdown), the cobbler is left to attempt to theoretically understand what is happening, and to consider the hammer in a different (present-at-hand) fashion. This model of the breakdown has been used both in negative instances of interaction design as a means to understand user difficulties with an application (Urquijo et al., 1993; Wright & Monk, 1989) as well as a positive example of the potential for what ubiquitous interactions should look like (Dourish, 2004b).

This sense of intelligibility can be expanded beyond a consideration of things when considered in the light of Das Man and the kind of social visibility that it brings. For MOOCs and the common social space that they inhabit, this sense of Das Man perhaps proves to be perhaps more important that other, more classic cases of intelligibility. It provides the social norms associated how students and instructors should comport themselves in a MOOC. Putting intelligibility in this frame, however, when one seeks to develop critical incidents out of the lack of intelligibility, it is necessary to develop a particular understanding of Das Man. Here, it is necessary to assert Dreyfus's (1995) positive reading of Das Man, one in which Das Man serves to support social interactions and read it according to the logic of the breakdown as above. This needs to be done, however, without affirming what would be the consequence of a breakdown of Das Man in the negative reading of it (Olafson, 1994a). Such a sense of authentic individuation that would result in a failure of Das Man in the negative reading is not what is at stake here.

In looking at intelligibility as mediated across networks of information technology, however, this sense of intelligibility is expanded beyond the relatively straightforward question of human intelligibility and includes a kind of non-human coordination of intelligibility that exists across things and the materiality of data itself (and as such takes on a certain Latourian (2005) flavor, though avoids any specific reference to Latour's sociology). As can be seen in the analysis of the course data, this non-human coordination of
intelligibility is a prerequisite for the human coordination of intelligibility. This shifts the importance given to human actions by the concept of Das Man to the surrounding equipment without which such social coordination would not be possible. For example, in cases in which access to course videos posted online is restricted because of government regulation, the lack of coordination between the users' system and the course platform precludes any coordination of intelligibility surrounding the course material presented in the video. It is this kind of material coordination of intelligibility that sets the stage for the more overt intelligibility of meanings shared by human actors and that is built up in large part through the engagements and interactions that occur in the course forums.

In many ways, this issue of the coordination of intelligibility cuts both ways across what Don Norman and Stephen Draper (1986) characterized as the gulfs of evaluation and of execution. This can be seen in the consistent concern expressed in the forums surrounding the successful recognition of the aims and requirements of the courses (the gulf of evaluation) and the persistent worry expressed by students surrounding the successful submission of assignments (the gulf of execution).

These concerns range across the questions of intelligibility that apply equally to human and technological coordination. Each of these questions engages the kind of reflexivity that Norman and Drapers' schema presents, a reflexivity which provides users with the security of knowing that what they know about a system and what they are doing is accurate and successful. In all the courses, there was a constant call for the need to better understand where individual students stood in the accounting and grading of the course. Similarly, and as will be detailed in more depth in an example below, there was a constant call for help in understanding how such a novel thing as a MOOC was designed to function. Where Norman and Drapers focused their formulation on the active conditions of use, this kind of coordination of intelligibility extends across the social system built up around the
MOOC and extends beyond these moments of direct interaction. In this, Norman and Drapers' gulfs are given a radicalized form in this work, in that these gulfs are given a socio-technical rendering that extends beyond the question of the use of an individual artifact, and takes up this divide as a general principle of coordination of intelligibility across a network of actors and concepts. It is within the space of these disjunctions that the work of designing the socio-technical systems of the course occurs, with each incident presenting a call to both designer and users for action. It is in answering this call through either changes in design or modified patterns of use and social behaviors that the work of socio-technical design happens.

**The Theme of Resilience**

A second central theme can be seen as these kinds of post-human breakdowns of intelligibility are spurred on by the resilience of technical and social systems. Just as the previous theme of the coordination of intelligibility focused on both human and technical systems, so too is the question of resilience spread evenly across these sometimes distinguished systems.

Where previous related concepts (such as “viscosity” (Green & Petre, 1996)) have been developed in order to explain the (often detrimental) inability to alter information once entered into a computer system, the sense of resilience that is seen as cutting across various types of incidents in MOOCs is equally applicable to both social and computer systems and can have both positive and negative connotations. So, while it is possible that the inability to alter information in a system proves to be a case of the mis-application of resilience, mirroring a positive reading of Heidegger's *Das Man*, this kind of resilience also supports and makes possible social activity. After all, if something is not resilient, how can any activity occur around it?
Given the focus on critical incidents and breakdowns, however, here, resilience is still largely taken as a negative: that viscus materials hamper the achievement of a productive interaction. This kind of resilience is characterized most directly by events such as the persistence of errors (either as typo in the course material or in the inability of students to revise forum posts once submitted) as can be seen in posts to the forums. Here, the first post is from an instructor and the second from a student:

[T]hanks for bringing this to our attention. You are correct, there are 17 questions for that quiz. Unfortunately, it seems that when quizzes are published in Coursera, that area is locked down from editing. Sorry for the confusion.

I uploaded a photo but found it was the wrong one, but was unable to delete it. I reuploaded so I ended up with two photos. Is there a way to delete?

Beyond these kinds of simple cases, this sense of the indelibility of the mechanics of an interactive system is expanded to include the resilience of an entrenched belief about education (for example, that by providing a compelling personal reasons students should be given extensions) or about MOOCs themselves (that all lessons should contain video lectures, when in fact they might not). As three different students put it when confronting various entrenchments:

I assume that there is a standard procedure in coursera to grade and normalise the evaluations so that nobody can be pulled down by two harsh evaluators. That would be normal University practice.
Sorry - but was this weeks lecture portion only 10 minutes total? Or am I missing a few lectures? (I'm not counting the bits with the envelope demonstration - just the lectures about artists.)

I can't see any Video lecture listing for Week 5 & 6 forward. I had no problems with Weeks 1-4.

This kind of resiliency makes attempts toward the modification of a course in media res difficult, with changes in the structure of the course meant to improve the coordination of intelligibility oftentimes reducing it. This proved to be the case when the deadline of the final assignment of the Maps course was changed in order to attempt to reduce pressure on students. While the net effect seemed to be palliative, the switch nevertheless prompted a wave of questions from students.

The resilience of time. This theme of resilience has a temporal character as well. In cases in which relationships between students and the course (as in the case of timed exams) or among groups of students (as in the case of peer review) rely on a coordination across time, the immobility of a deadline in the face of the progression of time was a frequent source of difficulty. For students facing a timed exam or deadline, each (metaphorical) tick of the clock marks the building up of a system of temporally-oriented traces which served to bind students to alternate conditions apart from the present. This is illustrated in one students' concern over missing their chance on a final exam:

I also made a mistake with the final exam. Thought it was lesson five quiz and clicked on it without knowing that it was being timed. I left my office and was SHOCKED when I returned sometime later and realized that I was supposed to be taking the
Final, and the clock was counting down. I tried my best to answer the questions as quickly as I could with the limited time that I had left. SUGGESTION: Could you place a “reminder” at the final quiz, that it is 'being timed” and the clock begins when you Attempt Quiz.

Under such conditions as a timed exam, the passing of time creates a resilience of trace that cannot be overcome. If the temporal marking of the passage of time indicates that a student is out of time on an exam, they are out of time. Of course, this kind of resilience of the marking of temporal conditions may be the intended effect of a timed exam, just in the same way as forum posts are meant to last across time so that they may be read by other students at a later date. The question here is the measure of control that is afforded the students, both in their ability to knowingly enter such a situation and in the design agency that such systematic temporal resilience removes from the students. In the case of a timed exam, students' ability to control the pace of the course is limited in favor of the instructors' and designers' control over the purposes and intents of the course.

The example of peer review. While the kind of temporal limits that a timed exam imposes are in large part fully intended by the designer who establishes them (or the expectations of education and the kinds of empirically-influenced methods of testing that such ideologies might put forward), another example is more problematic and certainly less intended. This comes in the kinds of conditions of temporal, material, and social coordination necessary for the utilization of peer review mechanisms such as are used in the Art course and to a lesser extent in the Maps course.

On the Coursera platform, peer review is structured so that only those students who have submitted an assignment (an artwork or map as in the present example) for peer review by a certain time are in turn offered the chance to review the work of others. This is done to
ensure that there is equanimity between those reviewing and being reviewed and so that only those who are still active in the course at any particular junction are assigned the work of other students to review. Once the deadline for the assignment has passed, each student who has submitted an assignment is randomly assigned the work of two peers to review, with the option of reviewing more.

As will be laid out in more detail following the examples from the forum data, students faced numerous difficulties, both within and without the defined territory of the peer review system. Given the temporal resilience built into the system in which it was required that both work and then reviews of others’ work be posted within the appointed timeframe, some students (for varieties of reasons) were unable to participate in the system of peer review. While such a temporal regulation is simply (like a timed exam) necessary for the function of the peer review, it is possible to look at how the temporal resilience of the system of peer review had wider reaching implications for the large socio-technical system.

Set within the large socio-technical picture of the working out the meaning of the function of MOOCs, students who were excluded from participating in peer review were, in effect, prevented from engaging in the socio-technical work of contributing to the development of the practice of peer review as found in the course. In either constraining or enabling students to engage in this kind of coordination of intelligibility, the material structure of the course platform itself stepped in and enacted the agentive preservation of its own conditions (this material embodiment of values occurring in a manner similar to that as discussed by Winner (1980)).

In the specific case of the form of the socio-technical system of peer review within the Coursera platform, it is by students engaging with these systems of peer review that they are able to participate in the design of the socio-technical system of the course in question, other courses in the future, and any other systems of peer review that they might encounter in
the future. Without the basic ability to engage in peer review, the students' influence on the socio-technical system of peer review is deflected away from direct influence and toward an influence only of attrition.

In focusing on the temporal resilience against participation, here are some examples of the difficulties faced by students in the peer review process. From the perspective of breakdown analysis, these could be each seen as individual critical incidents or they could be aggregated under the rubric of a single problem. In this case, these are examples of the difficulties faced by the students as they attempted to participate in peer review as reviewers:

Hello i have submit everything and i ’ve received a note telling me that we are automatically connected to 2 fellows classmates... I dont see anything? maybe it's too early? let me know.

I'm concerned that I have not yet received any art to evaluate and am wondering if anyone else has, I thought my artwork was submitted on time but still confused by the time difference

When I wanted to look at Student 2 work,it always show me server error. Can it be fixed?

I can only see one of the two pieces of artwork I am assigned to evaluate. Did the artist not upload the artwork correctly?

I have loaded my second student to evaluate and can see the artist statement, but not the artworks! What can I do?
I just went to the peer assessment page and started to evaluate the work of others. I can’t find the comment box, so I do not know where to put my comments.

I am doing the peer review at the moment and the only thing in one of the submissions is the following link: https://coursera-uploads.s3.amazonaws.com/user-cc2557016a32a0ff37f8b09c/970583/asst-7/970583-521479fbc38d74.62490532.htm (there was no screenshot as requested in the instructions). The problem is that the link opens but none of the images/maps display correctly. I have tried to open it in chrome, firefox and IE but it is all the same. Would any of you have any suggestions that might allow me to see the map? I would like to give this person a chance as it appears that they have at least put some effort into the assessment. Unfortunately if I can’t find a solution to this I’ll just have to mark close to zero.

There are some peer assignments that provide ONLY an url to a dynamic map that cannot be opened due to a lack of authorization (a sort of access denied). it is not possible to grade them! Does anyone else found more of this?

I cannot access the first map I'm supposed to review. I don't know how the submitter (without friends on the course) is supposed to check whether others can access his submission. As already a skeptic of coursera peer grading, I have to say that this one is the most technically fraught, and subjective, that I have come across.

I had to review a map that was in spanish.. fortunately I speak a little spanish, but I have no idea why people are submitting something in another language than english.
I did my peer assessments yesterday morning and submitted them. On looking at my results I see that I have a 20% penalty because apparently I have not done any peer assessments!

And these posts represent some of the problems mentioned from the perspective of those submitting their work for review:

I realise the stupidity of myself when I did the self evaluation. I paste a wrong link for my map.[…] Can I do something to correct the super stupid thing that I have done?

I did not receive any peer evaluation at all.. what shall I do? will this work count towards the overall course result?? I'm very dissapointed and upset, especially because I have evaluated a lot of works myself!!! very dissapointing!

My Updated Pictures were not reflected for Peers during assessment while the wordings I had used were reflected. I am totally surprised to see the result. I was travelling and I got a chance to see the result only now. Can something be done, now? Please

I received a lower grade from one peer that stated.. Please, do not upload your photos upside down. I DID NOT UPLOAD ANY PHOTOS UPSIDE DOWN! While not being a fair grade, I will accept this as human error on peers part. Assessing someone's work should entail looking long and hard, especially when it is critical. But, sometimes not right!
As is evident from these examples, problems seem to include anything from upload errors to server errors to missed deadlines to second-language problems. In all cases, the closed time frame of the peer review played a role in limiting the possibility to fix any of these errors, with deadlines for both the initial submission and the subsequent submission of reviews limited by the necessary coordination of the simultaneous activity of thousands of students. The resilience of the technical timing necessary for the function of the peer review locks these errors in place.

Beyond this sampling of issues that follow from an engagement with the peer review process presented above, other students reported missing their chance to contribute to the peer review process because they mistakenly submitted their work to the wrong place on the site. The indelibility of these traces (and the resulting indelibility of the students' position within the socio-technical system) is cemented by the persistence of the traces of time which close off the possibility of altering the location of the posting of their assignment to the proper location in the system. In this kind of rigidity, the technical system as established asserts its control in the continuing and iterative process of socio-technical design that continues through the process of use. In this, it is as if in Winner's (1980) account (which may or may not be wholly accurate to historical events, even as the meaning remains resilient (Woolgar & Cooper, 1999)) Moses's bridges blocked the transportation of buses containing not minority populations trying to reach the beach, but civil engineers on their way to meetings regarding a design of those very bridges. When systems close off participation in them, they act to foreclose any future possibility of any wider socio-technical development around them.

As in the case cited above in which the student denies posting their photos upside down, the kind of temporal closing off of the possibility of change and correction is
exacerbated by the kind of technologically-mediated veil that separates the work of the reviewer and the student whose work is being reviewed. In this, the novelty of the system, both as an innovative platform and as a perhaps unfamiliar technological paradigm for some users, contributes to the confusion surrounding the function of peer review. The impact of this kind of obfuscation caused by the novelty of the system will be discussed in more detail in sections to come.

Despite the temporal closing off of the possibility for some students to engage in the shaping of the meanings surrounding peer review, some students unable to participate in the process of peer review opened another avenue. Instead of relying on the formal peer review system, they instead organized informal models of peer review in which they would post their assignments to the forums, asking for any feedback possible. In doing this, they extended the existing function of the forums to facilitate peer review in lieu of a system which had, either by their own error or the error of the system, failed them. This refactoring of the use of the system proves to be a direct and visible example of the kinds of reconfigurations that occur through the continuing coordination of intelligibility surrounding the system. As will be seen further on and in the next chapter, this kind of extensibility plays a large part in the metaphysical definition of online systems.

**The Theme of the Interpretation of Incidents in User Data**

A central question for understanding the design of MOOCs and in the identification of critical incidents comes in the various ways in which it is possible to recognize and respond to critical incidents as they arise. This is an open question for MOOC designers, students, and researchers alike. In engaging with the forum data, it is evident that any number of conditions come to play a role both in the determination of what should be considered a critical incident and what should not, as well as in how these events should be viewed. This consideration
serves to lay the foundation for understanding how a typology of critical incidents should be
developed.

In large part, the scale of a MOOC plays a central role in how students and instructors
approach and respond to incidents in the course through the forums. As detailed in chapter 5,
an innate tension exists between understanding an incident as being represented by numerous
posts from various students versus the individual and personal expression that can be found
in a single post from one student. While much of this tension is demonstrated in
straightforward fashion with attention being given to those issues which affect a large
number of users, it remains a question as to how incidents particular to single students are
encountered. In this, there is the challenge of discerning the relationship between individual
students and the course at large, particularly when it comes to diagnosing and understanding
responses to critical incidents.

The contrasting breadth and specific semantic richness of the forum data points to a
unique and flexible valence of possible responses to critical incidents. In large part, the
valence of response cuts across the ways in which incidents are viewed as possibly engaging
a wider spectrum of the course beyond a single user and the potential seriousness of any
single report. On the one hand, even when reported in isolation, problems relating to the
availability of course materials (such as video lectures) have the potential to impact the
course in a way which extends beyond any initial and individual report. After all, what if it
turns out that the materials are not available to not just this one initial reporter, but any
students moving forward? On the other hand, other incidents such as reports of bullying are
often reported by and affect only a single user, yet these incidents are still likewise treated
with a seriousness similar to that granted to issues with course-wide implications. This being
the case when other incidents relating to individual students (such as missing a deadline
based on a time zone confusion) go publicly ignored. In this there exists a tension between
the question of broader effects of any incident. Single reports of minor issues that may affect a wider number of students are approached with a sense of seriousness, as are those that have a pointed and particular effect on a single student. Other issues, particularly those that are routinely faced by individual students, but without the potential for course-wide implications, are not given similar consideration.

This is not to begin an interrogation of what should or should not be considered a valid issue within a course. After all, the theoretical lesson of the work of design developed in previous chapters is largely that critical incidents, as events, should be approached as unique and singular problematics put forward and as such need to be confronted on their own, unique terms. This is, however, to explicitly raise the issue of the wide breadth of interpretive valence that exists in the response and naming of critical incidents. The responses to two particular types of incidents illustrate this unique interpretive and ethically-singular moment for those involved in the work of designing and running the course (and—in a less obvious fashion—those who, as users, contribute to the socio-technical development of the system). Neither of these examples are meant to stand out as particularly important incidents, but only as thematic illustrations that illustrate the spectrum of unique responses possible.

“39,000 video downloads by over 15,000 students.” This first example looks at reports of incidents in which the scale of the course is seen to work against individual complaints. This was the case at the start of the Art course when some students reported problems with the video lectures. The ability to track student interactions and having a view into aggregated student interactions allowed the administrators of the course to weight in on the incident from a quantitatively-informed position as one instructor put it:
I wanted to take the time to follow up on the intermittent video issues that some students reported which made it difficult or impossible to view some of the course lectures. The Coursera server statistics are telling us that in the first two days of this art course we have had over 108,000 streamed video lectures and over 39,000 video downloads by over 15,000 students. While we have had only a few reports in the forums about video problems, we do take them seriously and took the time to ensure that everything was working properly.

This matches the sentiment of another instructor responding to a different problem—a student who missed a deadline:

*I posted the time in multiple places, and you got an email from me about the timing as well. I'm not sure what else I can do. There is no delay possible - Coursera makes you choose a deadline and that's it - after the deadline, the reviewing starts. There are no submissions that can happen after reviewing starts. Thousands of people were able to successfully submit their work. It looks like a couple dozen were not able.*

It's not that the quantitative analysis (“we have had over 108,000 streamed video lectures and over 39,000 video downloads by over 15,000 students”) discounts any individual complaint, but that it provides a framework for understanding and relating to individual issues. In many cases, this contrast between the experience of individuals with that of the group highlights the individual nature of problems, and encourages processes of further investigation on the part of the course designer:
Could you provide more information on what type of error you are getting? We’ve had a large number of students already submit their quizzes successfully and I am not aware of any issues with the quiz.

This kind of numbers-first approach to understanding the function of the courses is not limited to the perspective of the course administrators, designers, and instructors, with students taking a thematically analogous approach, albeit one which might not be informed by the same empirical certainty. As one student put it when confronting the course designer's resistance to a change in video style proposed by students:

*It doesn’t matter what the videographer thinks. The most important perspective is the 80,000 Coursera students think. That's the approximate number of students who have started the Coursera classes that I have taken already. It would be easier if [the school] fixed their videos than all of the students who simply want to see the videos right side up. Is that so hard to ask?*

In each case, a kind of democratic ideal—that the majority comes to determine what are legitimate issue in a course—is enforced by the volume of students involved. The inverse of this is illustrated in the next example.

“*I am so sorry to hear about your loss.*” This sense in MOOCs that numbers matter is complemented by a distinct attention to the individual situations expressed in the posts, particularly those that, for a variety of reasons, demonstrate the unique position of the poster. The novelty of the individual position gives these singular posts a certain sway in determining the tenor of the course. This is most dramatically illustrated in instances of personal loss:
I really do want to take this class, but my husband passed away yesterday morning, and I just can't give it my full attention right now. I don't want to just quit and then not be able to take it later, so am not sure what to do. Or who to contact. Any help would be appreciated. thanks..

In these cases the social network of the course steps up to fill in and offer aid, offering both an outpouring of condolence and advice on how to exit the course, from both other students and instructors:

I am so sorry to hear about your loss. As Amy probably told you, we will be offering this course again in the Fall. Please accept my deepest apologies and please let us know if you have any other questions.

Such response is not limited to instances of explicitly personal pathos. Similarly supportive responses and offers of extra assistance were also found to the norm for students reporting difficulty accessing course materials because of local restrictions on Internet access. In these cases, complaints relating to a lack of access to course materials because of national restrictions on Internet access elicited responses of help and recommended workarounds from students and staff, regardless of the the overall number of students affected by an issue. In each of these examples, whether it be personal loss or international intrigue, what comes to matter is the development of a compelling narrative around a problem or question. In appealing to the better natures of students and staff, these wholly individual concerns oftentimes receive the attention required.
The distinct valence of responses to issues of strikingly different scale represent the dynamic perspective that the large set of data available in MOOCs presents. In this, the critical incidents that drive forward the design of the system are bounded both as singular moments in the course (in the more traditional sense of a critical incident that is specifically located at one particular moment of time) and as diffuse events which are spread across the actions of large number of users. In recognizing incidents in both a reflexive manner (as those involved in the course recognize them) and from the perspective of research, incidents are seen to arise out of the total action surrounding the course. That is, in the divergent scales at which incidents are recognized, it is possible to conceptualize the manner in which the total action of a course, both at a micro and macro level, contributes to the shaping of critical incidents which are seen to drive forward the work of socio-technical design.

**Two Examples**

While the forum data offer almost innumerable illustrations of these types of critical incidents, two general types of incidents will be detailed in order to provide added depth to the explication of the typology. These two cases confront the questions of the sheer novelty of MOOCs and the difficulties encountered with such a scale. In both, the various modalities of the work of large-scale socio-technical design under the aegis of large sets of data are developed. They each address aspects of contemporary conditions of design that are the focus of this research: the novelty of having access to such outsized volumes of user data. In the first case, an engagement with the novelty of the system demonstrates the role that the conceptual development surrounding a system plays in the design of a system through its use. In the second, both the impact of the scale of the courses and the variety of responses to similar challenges faced by the designers and instructors of a course are demonstrated. These two broad approaches signal specific characteristics about the socio-technical system that makes MOOCs and their design unique.
Example 1: Novelty

Maybe you can tell me something - I've been too afraid to ask because it's clearly a stupid question, but you seem like you'd know and not judge me - what does MOOC stand for? I'm guessing "online course" is in there, but can't guess the other letters.

Above all else, the defining feature of the socio-technical system presented by MOOCs is their novelty, as they take established paradigms of education and online communication and present them in a unique configuration, both in their forms and in their intents and purposes. In this novelty, users face questions about how to navigate the use of such systems and, as explicated in the theme of the coordination of intelligibility, what a MOOC is meant to mean. This can be seen in different responses from students:

This is my first time taking an internet class. I am finding it difficult to follow the steps in the process. Does one go to the “Weekly Lessons” link, or assignment due dates, or assignment details? Is the first week about the fantasy art, or is that something different? I am in the process of listening to/watching the video lectures. When I finish those, what do I do next? Thank you for any help you can give me. I guess I need a step-by-step road map, just like the kind I give the students I teach! And I teach elementary school! p.s. What is a “bug” report?

This is a five week course - it's just a taster. Some people are talking about evaluations as if they're evaluating doctoral dissertations. It's ridiculous! I think we should lighten up and enjoy!
I am interested in this class; however, I also need to extend my teaching credential with classroom hours. Can this class do that, even if I need to pay a fee?

This sense of novelty and uncertainty extends beyond just the functional elements of the course, or even the purposes and expectations that are bound up with it. It is not just about how to engage with the system or what the outcomes of use can be. In large part, the novelty presented by MOOCs is demonstrated as they rework paradigms in support of both traditional and online education. This restructuring extends beyond the specifics of the system and extends and is disseminated to wider spheres of social interaction (Daniel, 2012; Russell et al., 2013). In the model of education offered by MOOCs, there exists a tension between the formal structures of traditional classroom education and the more open stance taken by many online platforms. This tension is not only expressed in the formal challenges that MOOCs present to traditional models of education, but also in the anxiety encountered by students as they attempt to navigate between these two distinct worlds and as they both figure out and contribute to the invention of the function of MOOCs. Questions and doubts surrounding the timing of the course, grading policies, and expectations regarding the need to engage with lectures and assignments permeate the course forums.

These questions come not only as MOOCs in general press against traditional education, but, as in the discussion of the theme of coordination above, as the policies and approaches of one MOOC differ from another. What is the norm in one MOOC is not in the next, eliciting a sense of novelty even between MOOCs themselves. Even further, within all this working out of the new territory covered by MOOCs, there is an understanding that, within a single course as students learn its norms and policies, these norms and policies can be disrupted by novel changes within a single course. This could be clearly seen in one of the courses examined as there was an abrupt shift from a reliance on video lectures to having the
lectures only in text form. After this shift, numerous students posted reporting errors and looking for video lectures in cases where there were none. After becoming familiar with the way in which it seemed that MOOCs were designed to run (with video lectures for each unit), students faced the challenge of re-orienting their expectations and practices surrounding the course. The novelty of the form comes to cut both ways, with those on the teaching, design, and administrative end of the system likewise reaching across paradigms and re-factoring their understandings of the function of MOOCs as they engage with it for the first time.

**Novelty, technology, and design.** Throughout all of the courses examined, these paradigmatic questions of novelty resonate with the aspects of technological novelty presented by MOOCs. After all, it is a developing field of technological possibilities (and a recognition of these possibilities) that make MOOCs possible in the first place (particularly in the ontological sense as discussed in chapter 3). Even in the case of incidents in which student confront a pedagogical novelty, this novelty is bound up with questions about the formality of the system:

*Is there a way for keeping track of my progress in this course? I am asking because I read that the grading here will depend on a number of elements including forum posts, comments, completion of activities, besides the quizzes. And while it is possible to check the quizzes results in the dedicated tab, I can’t see how to monitor the forum participation, unless counting the interventions made on our own (which would be OK if not having multiple courses going on simultaneously). Secondly, it would be very helpful to define what is considered a “post” (only new threads?) and what is a “comment” (I noticed that I can “reply” to discussions opened by others,*
but that I can “comment” only the replies of third students and apparently not
directly to the discussion owner's message)

In this particular case, the novelty of the technological system for managing and tracking course interactions is complicated by the wider issue presented by MOOCs of being able to have “multiple courses going on simultaneously.” That is, as they are largely gratis and open to casual enrollment, in this particular case, the student seems to confront not only understanding the technological paradigms for one course, but for a host of courses simultaneously.

For users, their experiences with online systems previous to and during the course seemed to color their impression of the reliability of online systems. Particularly for novice computer users, the novel paradigm of online learning proved to be especially challenging. Beyond having to reorient themselves to new pedagogical strategies as they shift to an online framework, novice users also have to overcome several hurdles relating to technological skill in order to engage with a course. In this, user engagement with data-rich online application such as MOOCs comes to presuppose an ideological commitment to regimes of computerization on the part of users (Marcinkowski, 2015). It goes almost without saying, but if users want to participate in MOOCs, they must acquiesce to the forms and techniques of computerization. This echoes the question of the relationship between education and technological design as discussed in chapter 3, though turning the idea of general technological practices to face users instead of designers and educators.

The sense of novelty present in MOOCs and the openness toward the future development of the paradigm is thus understood to be dependent on and limited by preexisting paradigms of computing. While it is possible for MOOCs, in their novelty, to re-shape the social and educational systems which they bring together, at bottom, technological
paradigms and patterns of online interaction remain untouched. While these paradigms might change and develop through the design, deployment, and use of MOOCs, such development is not bound to the educational paradigms that are brought to bear, but instead come about due to the influence of already-existing regimes of computerization. This is something that applies equally questions of design and use.

So, while tensions between already-existent and new paradigms in MOOCs open the space of the work of design to both users and users, this space remains, at its core, limited to the possibilities offered by the material space of computing. Following a structured model of social development as laid out by Althusser (2005), any social or ideological innovations that may arise in this novel space are, in the last instance, directed by the material technological substrate on which they rely.

At the same time, however, the unique technological affordances presented by an online system also offers, within itself, a kind of flexibility of determination that might not otherwise be possible. In their networked constitution, MOOCs (mostly though the forums) are easily extensible as students link to other resources, post their own reflections on the course, or point to other online platforms that can complement the official online spaces of the course. There is a sense that the “technological” setting for MOOCs presents the possibility for some escape (or at least continued and iterative development) away from any staid paradigmatic perspective.

So, while MOOCs may in some ways be constrained because of the technological commitments on which they rely, the fact of their technological centering provides an opening for students' involvement in the process of engagement and negotiation. The single requirement present for a student to enroll in a MOOC is having access to an Internet connection; and it is this single characteristic that allows for the almost unlimited extension of the meaning of what any MOOC is or what MOOCs in general are. MOOCs are bounded
by technologies, but the technologies that they are bounded by are technologies that encourage the kinds of extension, sharing, and communication that point students and their understandings of MOOCs in new directions. This specific theme is something that will be returned to later in discussing Gianni Vattimo’s (2004) critique of Heidegger’s view of technology.

That said, the social configurations of use that surround the question of novelty in MOOCs exists under a wider set of techno-scientific conditions than just those found in MOOCs or even computing. These regimes which more broadly define human activity (as explicated most directly and fundamentally by Heidegger (1977) in “The Question Concerning Technology”), while ontologically limiting the development of social configurations, have become tacit to the degree that, for users engaging with courses and socio-technical systems under their purview, the process of social configuration appears to remain largely uninfluenced by these last material instances. This is a theme that will be discussed in considerable detail in chapter 7.

**Example 2: The Forum Posting Requirement and Scale**

As the previous example highlights the openings created by the novelty of the course, this example serves to highlight the different types of response that are possible when confronting clusters of similar incidents. Here, the valences of possible responses to the challenges posed by the outsized number of posts in the course forums are examined. Most basically, this example illustrates the particular and situated nature of any design decision when confronted with a field of data. In doing so, this example highlights the various networks of factors that can come to play in issuing any design decision, with such a varied field of factors relegating the process of decision in design to a position of seeming arbitrariness. In casting such decisions as seemingly arbitrary or random, the particular
Derridean sense of the ethical decision as fundamentally unique and undecidable is showcased in this kind of socio-technical design.

In all three courses, students reported that the volume of posts was oftentimes too great and too intimidating to be able to begin to feel that they could make a contribution to the forums or manage their involvement with the course. As put by two different students:

I signed up for this class just yesterday and today found 118 pages of posts to read...a bit daunting

Goodness, there is now over 240 pages of threads as we approach the end of Week 1! I'd like to actively participate, but with this much noise, I can't do more than hope an interesting thread happens to be on the first page at the time I happen to take a look. Oh well...

This extended even to the overwhelming number of email notifications received by students to alert them about students' responses to their comments:

can you tell what to do so as not to be overloaded with emails from the other students? 600 this morning and tell me how I can participate to the forum... sorry for not being so at ease with tecnical aspects and computers

In most cases, this kind of grousing is met with straightforward advice that speaks to the kinds of meanings that students should ascribe to the course:
You are not expected to read all of the forum posts and comments. Just find someone who doesn’t have any comments and start there. Then scan titles and see if something interests you and post if you have something to add.

This kind of appeal to a reorientation of priorities was met with the practical difficulty in the material design of the forum system:

in order to add a new post in a thread, it seems we have to scroll all the way to the end of the page. In the introductory forum, for example, this is getting kind of annoying since the amount of replies/comments/posts is huge! Is it maybe possible to create the ‘add new post’ button at the TOP of the page, instead of the bottom?

As well as in the social difficulties that such a mass of commenters presents:

The way I see it, the biggest problem we have is not a problem with the course per se, but a problem that when you get 50,000+ people together, you inevitably end up with quite a lot of whining and attention-seeking behavior in the forums as well as a lot of unnecessary posts from people who didn’t bother to read the instructions carefully asking questions that were already answered in the instructions. This clogs up the forums with a lot of garbage that has little educational value and makes the content that is valuable more difficult to find. It’s a signal-to-noise ratio problem. This is something I have seen in other Cousera courses, although it has been quite pronounced in this course.
In one instance, the instructor responsible for the course sought to ameliorate this issue by creating a weekly digest featuring the posts that seemed most salient:

*In this post I'd like to highlight some of the excellent threads I've seen so far in Week 1 of the course. This is a bit of a cheat sheet for those of you who are daunted by the number of possible things to check out. I'll try to do this each week hereafter.*

In other cases, bad actors created an environment which threatened to keep students away. As one student put it: “unless you clear out argumentative smart ass TROLLS like this guy, then i won't be coming back.” In these cases, students were encouraged to ignore negative posts, with problematic posters being admonished. That is, design changes came in the design and redesign of social practices. As with the call for a reconfiguration of expectation, the responsibility of the design of the course is seen as being shared across spectrum of participants of the socio-technical system.

These responses to the complex difficulty presented by the scale of the course forums show the various and multifaceted approaches to the reconfiguration of the socio-technical system of the course that were instigated based on student feedback. In these cases, the necessary changes were the providence of both traditional centers of design agency (the staff of the course) as well as a wider field of social engagement which involved a reconfiguration of exceptions and norms. In these initial responses to the question of the scale of the discussion forums, the ameliorations came through the moderation of expectation (just review the threads of interest) and subtle design changes (reconfiguring the discourse to contain a retrospective look at the forums).

These issues surrounding the outsized number of posts in the forums are only compounded when use of the forums becomes compulsory as it was in two of the three
courses that were examined. In the Maps and Energy courses which included student activity in the forums as part of the final grade, students in both of the courses were direct in their doubt about the value of such a requirement:

*I always found grading for participation in MOOC discussion forums a bit... Odd? Don't you think it would become more a formality, than a participation of engaged?*

*I am surprised Coursera allows this course to attach portion of grade to discussion forum activity. I can list lots of reasons that the grading of this is unfair, i.e. measuring something different per student. Its all based on the fact that an online course is predicated to folks taking course at different times during the week (some work M-F say) and so there is a difference in the amount of forum discussion for different students at the time they can first get to it. Note that the grading is attached to making an "original post" which obviously gets progressively harder as the time goes by.*

Not only was such a posting requirement seen as counterproductive, it was also seen as compounding problems associated with the volume of posts:

*With the requirement for an original post, I think many people are starting a new thread rather than giving a +1 or making a comment on an existing thread. There are so many threads that just looking at the list of names takes too long.*

In both the Maps and Energy courses, there was significant pushback to the posting requirement. It came to be such an issue in one course that the instructor had to make a
special forum thread just for complaints in order to contain the issue entitled “Post Here About How Dumb My Discussion Grading Policy Is.” The effect that this had in each of the courses, however, was different.

In the Maps course, despite the strong response, no significant change was made to the policy of requiring use of the forum by students. The resilience of the requirement continued even alongside softer design changes, such as the digest outlining important posts as noted above, and a continued dialogue with students about reasons for and expectations surrounding the posting requirement. In the Energy course, similar complaints were answered with a direct change in the design of course requirements and the development of a tiered system of accomplishments for the students by which only those wishing to receive a certificate “with distinction” were required to post to the forum.

In some respects, the difference in response can be understood as the personal reaction of a single instructor responsible for the decision. As the instructor of the Maps course put it, this decision not to change the posting requirement was born out of previous experience with and knowledge of online teaching:

*I believe that developing a rapport with your classmates is an essential feature of effective online learning.*[ . . .] *Discussions make online classes work.*

In this case, the previous experiences and traditions of educational theory pushed the instructor to maintain the configuration of the design of the course to continue to include mandatory posting. Even though significant user feedback indicated that such requirements were onerous, it was judged that the mandatory postings were central to the function and value of the course over and above any user complaints.
Factors of decision in design. The case of the divergent reactions to student complaints about the requirement of forum posting presents a telling account of the work of the design of a large scale social system. In the case of the Energy course, the designers and instructors responded to user feedback by choosing to alter the design and function of the course by rescinding the posting requirement. This follows (on the surface) a traditional model of the centering of design agency: the designer decides to make changes based on feedback data from the users. In the case of the Maps course, there was no change made to the policy requiring student participation, despite similar feedback from users. Instead, the importance of the policy was reiterated and the mechanisms for grading were clarified. In this, the instructor sought to change students’ attitudes and understandings of the socio-technical system of course. In both cases, even when material changes to the design of the course are made, students are asked to put aside their personal problems with the posting requirement and to change their expectations or (in the case of bad actors) they are asked to modify their behavior. The pointed action of individual designers, whatever their decision, takes place within a wider field of socio-technical engagement.

The question of the site of agency is not limited to the valanced responses of the instructors and designers to feedback from users. This distribution of agency concerning the continuing work of shaping the course extends to the material function of the paradigmatic system of the online forums themselves. This material agency comes both in the basic affordances offered by online forums and the resiliency of these affordances. Most fundamentally, the affordances offered by online forums allow for the public posting of text from course participants from around the world in a manner in which the text is (as above) resilient and semi-permanent. That is, it is made to exist even after the initial expression which it represents is gone. Online forums rely on a properly deployed mode of resilience as described in previous sections. For users, engagement with forums as a general system has
two important requirements. First, users must spend the time and effort composing posts, and second, that they will be willing to potentially having those posts read by a large cohort of unknown students from around the globe. Each of these requirements are tied to the students feeling that there is some value in them. For the designers and instructors, there is a similar commitment to the use of the forums, in that they must build, support, organize, and see value in the use of the forums. In this, there is a shared and intelligible commitment to the value of the forums by both designers and users, a commitment which begins to blur the agentive foundations of a traditional understanding of design.

This kind of commitment necessitated by the affordances of the technical system continues to demonstrate the distribution of design agency that exists across the whole social system of the course. This system extends to not only designer and users, but also the material networks their actions are mediated by, as well as the broader historical settings which color their engagements. The affordances offered by the technological construct of the forums lays the basic grounding on which any design activity (whether undertaken in a traditional fashion by the designers and instructors or through socio-technical reconfiguration) can take place.

Regardless of the particular outcome that results from a critical incident (in this case, whether a change was made to the posting policy or not), the whole information system acts together in order to elicit some configuration of the actions of the designers, users, and systems involved. This occurs against a material-historical background of previous experience and material configuration. Such material-historical background is provided by both the function of the forum system, as well as the widely-set materially-instantiated cultural and educational-theoretical formations of previous experience which influence the decision as to how best respond to feedback from users.
At bottom, the matter of the solicitation of the change in forum posting policy appears differently across all the courses, with students expressing different reservations, complaints, etc. about the system, with the forums playing a unique role in each particular instance. In each case, the responses from designers, instructors, and students was different and, in the logic of an event, unique. Each course operates within its own, unique situation. The question of the decision of the individual designer and what influences their decision becomes (outside of a basic and flattening statistical accounting possibility) a fool’s errand: there is no end in sight to the variety of influences and decisions made. These decisions exist across a network of incidents and events that extend back even beyond the moment of the incident in question—this in the mode of a Derridean consideration of the never-ending chain of signification presented in *différance*. For any outside observer attempting to account for the cause of any particular decision, the work of design, as it spreads across designers, users, the systems, and historical configurations come to appear as arbitrary and without reason.

Put into a large frame than just one decision regarding the requirement of forum posts, it is possible to apply what is seen here not only to further specific design questions in the running of a MOOC (how deadlines should be handled, the requirements for peer review, etc.—examples which present a similar agentive field spread across designers, users, systems, data collected, the wider history along which they come together) , but also how such questions should be identified. Such a question of which design issues raised over the course of an online class is one which turns again to the question of the importance of singular complaints versus those issued by a wider array of users. When approaching the design of large and data-intensive online applications, it becomes apparent, as in previous chapters, that the work of design, like the data that scaffolds it, relies not only on both on a particular and eventful moment of decision, but that those kinds of moments are spread across the entire system at work.
Discussion

This analysis of critical incidents surrounding the development of the socio-technical system represented by MOOCs provides a view into the kinds of particulate and overarching events that shape and offer an opening to the continual process of design and reconfiguration that surrounds any large scale socio-technical system. These incidents, like the work of design itself, function as events and serve to guide the situation of design in decidedly non-empirical ways. While the aggregate occurrence of these critical incidents may influence the work of designers through empirical methods of analysis, the sheer fact of the occurrence of these incidents and their representation in the course data propels the design of the course along. The network of traces left in the forums represent student engagements with the course and serve to mediate the relationships between the designers/instructors and the users/students. Importantly, these traces interlock with and rely upon wider networks of historically-constituted socio-technical relations as is evident in the examples of novelty and the various agentive aspects of the question of scale in technological system of the course discussion forums.

The typology that is developed does not attempt to provide simply a symbolic representation of phenomena. Instead, it seeks to provide an abstract framework for understanding the situation faced in the design of MOOCs, as dynamic and various as this can be. In accomplishing this, two important characteristics of these critical incidents can be systematically appreciated. First, it is characteristic of these incidents that they exert their influence both as singular, unique events and as they are spread over a population of users. Second, these abstracted types of incidents, as they represent complex, real-life phenomena, are not isolated from one another and a single real-life incident may be represented by multiple types simultaneously and as one type of incident cascades to create subsequent and
closely related incidents. In this, the typology developed remains useful across a wide range of incidents as they occur at different scale and as they develop over time.

In creating this typology of critical incidents, it becomes possible to chart the influence that these incidents have on the design of MOOCs. This is not positioned as a deterministic influence, but one that simply marks off openings and potential sites for the practice of design, both by designers and, in less direct ways, by users. As such, these types provide markers for the future development of the socio-technical system of MOOCs.

In tracing out the theme of the historically-situated coordination of intelligibility that permeates these events, the work of design takes on a decidedly hermeneutic character: with its need to find alignment with broader configurations of socio-technical arrangement, the work of design is largely the work of understanding. It is entangled with not just the immediacy of a present recognition of need, but is tied to a broader, historical set of concerns which come to support and make possible any future work of design. In reflecting on the kind of understanding that is engendered in a hermeneutic movement, Gadamer (2004) formulated hermeneutics as being explicitly tied to this historical sense:

A hermeneutics adequate to the subject matter would have to demonstrate the reality and efficacy of history within understanding itself. I shall refer to this as “history of effect.” Understanding is, essentially, a historically effected event. (p. 299)

This alignment of design with understanding presents a picture of the continually generative work of design as, again following Gadamer, "if we understand at all" it is "in a different way" (p. 296). In this way, as design and the field of its action is given this hermeneutic character, it is possible to see how the double back and forth that exists as designers engage with both the course and its data that these incidents work to drive design forward. As these critical incidents mark out the movement of the history of the course, through design, it comes to be understood differently.
The critical incidents plot out the dynamic and symbiotic relationships that exist in the socio-technical amalgam of an online course between the complementary work of design and use. These incidents demonstrate the openings created through the use of the course which invite both the contemporary and future work of design. Through this mutual engagement, these incidents delineate specific instances in the mass of course data with which the designers come to think.

What becomes important to note here is that this kind of understanding that is established through the coordination of intelligibility is not something that is shared in a symmetrical or even reciprocal fashion. As historically-constituted understanding, it is re-factored in every instance. As seen in the multiple and various ways in which designers and users each addressed the question of design in the face of the volume of objections to the required forum postings, the understandings that each event engender are specific to each instance, each individual designer, and each unique moment in the course. The intelligibility that a course creates is unique across the entire span of the course. In each moment, designers are pushed to “think with” the data of that particular moment.

As designers and instructors engage with the forum data during the course and as a mode of retrospective reflection in the identification of problems etc., the inscribed traces of the data left in the forums comes to take an active role in guiding the work of design and reconfiguration. The texture of the forum data begins to bubble up, disturbing the surface of design. This typology illustrates these bubble in abstract, crystallized form.
Chapter 7
Truth in Design and the Question Concerning Big Data

This diagnosis of critical incidents serves to both reinforce and challenge the understanding of design that has been heretofore laid out. What an analysis of these incidents shows is that not only is the work of design itself eventful and contingent upon the historical happening and incidents which buoy it along, but also that such events of design are ontologically level with the events of use which propel it. In these critical incidents it is possible to see how the event of design is traced out by the events of use that come to be represented as abstracted critical incidents. In this, it becomes apparent that the work of technology design is not composed of only those activities undertaken by someone who is given the privileged position of “designer,” but that the work of design itself is an emergent condition consisting of design, use, and the materials of the work around it. In the case of large scale socio-technical systems (such as MOOCs), these materials are explicitly defined in terms of a socio-materiality which includes social practices, configuration, and the wider historically-determined field in which these exist. Put more directly, designers work with the representations of user activities and attitudes as they are found in the data that mediate the relationship between designers and a large mass of distant users. As explicated earlier, the socio-technical forms, more than any bits or technical systems, become the material of the work of design.

The network of critical incidents developed in the previous chapter maps out the eventful encounter of both designers and users with the openings in the system that these incidents create. These openings come as an affordance to the work of design, inviting both designers and users toward an engagement with the design of the system. This follows a perceptual model of affordances developed by Susanna Siegel (2014), who characterizes an
affordance as the mandate of an object, though here it is conceptual rather than perceptual object. In this case, these openings, as they call out for the work of design (as either in a traditional agentive model or of a more social shaping model of design through use), present the engagement of the total field of design, use, and the material-technological setting as being implicated in the responsibility for design. Rendered in this way, what is left to understand is how this field of the happening of design may be conceptualized, and what the wider implications for this setting of the relationship between big data and the design of large-scale socio-technical systems may be.

In order to explicate and trace the broader sociological implications of this conception of this field of emergent and autopoietic action, this chapter will look at the relationship between big data and design through the lens of Heidegger's “The Question Concerning Technology.” Central to the development of 20th century sociological critiques of technology (Borgmann & Mitcham, 1987; Cass, 1998; Ihde, 2010; Matthewman, 2011; Riis, 2008; G. Smith, 1991), Heidegger's essay presents a phenomenological account of the constraining power of technology and the danger that it was thought to pose to human being. The re-reading presented here aims to develop how, in contrast to the kind of limits that Heidegger saw technology placing on aletheia, the conditions of large scale data may encourage the mode of disclosure that is found in the work of design. Particularly motivated by recent (perhaps illegitimate) calls to step out from under the shadow cast by Heidegger in the area of technology studies due to his hateful politics (Fuchs, 2015), this re-reading will, in some small way, attempt to dismantle the dogma that has been built around Heidegger's approach to technology and offer a perspective which is not dismissive out of hand, but instead approaches his work in a manner which is both critical and generative.
Truth and Uncovering in Design

In reconfiguring Heidegger's approach to technology in order to be able to have it address questions of big data and design, it is necessary to first lay out a characterization of the connection between design and the kind of truth of revealing or unconcealment (*aletheia*) that Heidegger sees as being threatened by the essence of technology. As has already been developed in small ways in previous chapters, design is able to be characterized as a truthful nurturing of the unconcealment of Being that occurs in a manner that is essential to the nature of *Dasein* and is analogous to the making of a work of art as this is conceptualized in Heidegger's (1993) phenomenology.

To start exploring the question of the relationship of design to truth, it is helpful here to first turn again to Simon (1969) and his description of the work of design as any course “of action aimed at changing existing situations into preferred ones” (p. 55). For Simon in this initial definition, design has an innately humanistic quality to it. Design is seen as something that is bound up with our will and desire as the located and active subject collides with the resilient or semi-resilient world around them. Such was the case described in the previous chapter as the critical incidents pointed to design openings in cases in which the system, as established, proved to be resilient in the wrong ways. The work of design is that which pushes against this resilience in favor of human desire or will. That is, design is a human enterprise, and as much as the project begun by Simon seems at times to try to escape this humanistic paradigm (Newell, 1980), it remains trapped in it by the singular question of the will to change. From this perspective, while design may rely on some of the tools and methods of the natural sciences, the criteria for veridiction in the work of design rely on criteria developed in the human sciences, this as the criteria for technological success is developed from an adherence to a human epistemic criteria established previous to any technological work. That is, judging the “truth” of any technology relies on a decision about
what is wanted in any given situation and how this is reflected against what is judged by the human sciences to be the truth about current human social relations.

As work in the philosophy of science has demonstrated, our appreciation of the realities of the world come, broadly put, through a combination of engaged and discursive practices. As already laid out in chapter 4, this perspective is found to varying degrees and in different ways in hermeneutic, realist, and feminist discourses of science. So, while someone like Barad (2007) highlights an engaged combination of ontological and epistemic reality from a feminist perspective, Bernstein (1983) would consider the hermeneutics of the veridical judgment. In this, the theme of an engaged and discursive scientific inquiry is one that ranges from the most basic aspects of an evaluation of truth all the way up to the question of the public debate of science. It is one in which the total system of scientific veridiction is open to negotiation or reconfiguration given the particularly present (or not yet present) configuration. Given a Derridean rendering noted in previous chapters: the truth of science comes to us as part of a reflexive field of trace that cannot be determined in advance.

In many ways providing historical root to these (relatively) recent strains of engaged and hermeneutic philosophical approaches to science, Heidegger (2010) gave the question of Being and fundamental ontology priority in relation to scientific work:

Ontology can only contribute indirectly to the furtherance of existing positivistic disciplines. It has a goal of its own, provided that the question of being is the spur for all scientific search over and above the acquisition of information about beings. (p. 51)

In this, Heidegger cites the ontological question of Being (which he seeks to find explanation through the engaged understanding of Dasein) as the driving force of scientific research and presents his phenomenology as providing access to an understanding of Being in the form of its unconcealment. For him, this uncovering of Being is previous to the possibility for any
particular scientific knowledge, a theme that is taken up by both Bernstein and Barad, albeit in different and sometimes critical ways.

In developing his phenomenological approach to understanding fundamental ontology, Heidegger (2010) relies on the Greek concept of *aletheia* or “uncovering” in order to explicate the possibility of a human relationship to Being. Taken in some sense to be synonymous with our modern concept of “truth,” *aletheia* poses the idea that truth, rather than being a positive concept, can only be understood through a process of uncovering. It is not that there exists some final truth that can be explicitly demonstrated, but rather that truth comes only as it is uncovered. For Heidegger, this clearing away is an active process, and one that, in its human mode, is intimately connected with *Dasein’s* way of being rather than as an initial stance. In relating this figure of *aletheia* to the question of design, it is perhaps best to consider the world-disclosing power which Heidegger (1993) saw in the work of art.

*Aletheia* and the Work of Art

In putting forward the work of art as something which engages in the kind of unconcealment found in *aletheia*, Heidegger sets up a model for understanding the product of the work of design (particularly something as an interactive application) as also engaging in this kind of unconcealment. What is important to note immediately is that Heidegger (1993) separates the qualities of what makes a work a work of art from the purely “thingly” qualities of the material from which it is made:

The artwork is, to be sure, a thing that is made, but it says something other than what the mere thing itself is, *allo agoreuei*. The work makes public something other than itself; it manifests something other; it is an allegory. (p. 145)

With that, there is a sense that a work of art is able to make manifest some sort of allegorical proposition which is to be interpreted by someone else for it to be properly realized. Some made thing that is not a work of art, such as a piece of equipment (a shovel or
a hammer, for example), does not elicit such a response, since they have the possibilities of
their use circumscribed beforehand. In the case of a work of art (and in the case of
interactive technologies, I argue), there is something else in the thing's constitution apart
from its immediate materiality that calls for a certain mode of response. That is, there is in
such a work of art or application some quality which brings forth something which is not
present in the thing itself. As Heidegger (1993) puts it:

[t]he actuality of the work has been defined by that which is at work in the work, by
the happening of truth. . . . This means that the actual work is here already
presupposed as the bearer of this happening. (p. 182)

Following this conception of a work of art as being concerned with truth, and further
supporting a connection between technology design and works of art, is Heidegger's (1993)
understanding of a work of art itself based on a sense of techne in its movement of a
purposeful unconcealment:

Techne, as knowledge experienced in the Greek manner, is a bringing forth of beings
in that it brings forth what is present as such out of concealment and specifically into
the unconcealment of its appearance; techne never signifies the action of making.

The artist is a technites not because he is also a craftsman, but because both the
setting forth of works and the setting forth of equipment occur in a bringing forth that
causes beings in the first place to come forward and be present in assuming an
outward aspect. Yet all this happens in the midst of the being that surges upward,
growing of its own accord, physis. (p. 184)

With all this, there emerges an image of design as having little to do with the actual made
thing which is home to the design, but the possibilities that such design opens up in its mode
of unconcealment (an idea seen already in previous chapters' renderings of the social
materials of design and the concept of the general technological practice). The new
application is seen as opening a world which is able to, within itself, contain multiple
potencies of interpretation. Such a work engages in the play of concealment and
unconcealment found in *aletheia*. In this, a work of art or a truly innovative application opens
its own clearing within which various truths may be shown and concealed. As in the
discussion of *physis* above, Heidegger asserts the relationship between the work of the artist
and the kind of nurturing revealing that, as will be seen, is threatened by the essence of
technology. That is, the work is something that is both its own cause and is caused by
another.

What is important in all of this is that the nature of a work of art or design cannot be
predicted in a causal fashion, with Heidegger (1993) asserting that

[...]he curious fact here is that the work in no way affects hitherto existing beings by
causal connections. The working of the work does not consist in the taking effect of a
cause. It lies in a change, happening from out of the work, of the unconcealment of
beings, and this means, of Being. (p. 197)

As such, any view of design cannot be measured in a lock-step fashion, but must instead be
seen as bringing-forth something that is not only novel, but something that is also engaging
and to which users may respond. It is in the world that is opened up by a new application that
users are free to respond in their own way. As has been demonstrated in the case of MOOCs,
this freedom of response is a key aspect of their function.

In the end, this understanding of the design of technological systems as a mode of
*alethia* and as demonstrating a view into Being sets up a questioning concerning of the
relationship between Being and technology, particularly as this technology and the work of
design that brings it about comes to be enmeshed in a wider field of socio-technical action
and data. Design, at its best and most successful, as it nurtures that which is already present
to grow, should be understood as the this kind of truth of uncovering and unconcealment.
The Question Concerning Technology

In beginning to understand the field of designers, users, technologies, and data as they all come together to design the systems with which they have to live, there comes to be a need to understand the relationship between technology and what is (Being). Approaching this synthesis, a re-reading of Heidegger's (1977) essay “The Question Concerning Technology” is undertaken. Just as Heidegger saw the advent of new technologies at the mid point of the 20th century, we are today likewise confronted with something that is similar and as all encompassing as Heidegger saw it, albeit in a radically different way. For Heidegger, the advent of 20th century technologies threatened established modes of unconealment which relied on the human nurturing of Being in favor of mode of un concealment that is not a nurturing, but a challenging forward. For Heidegger, the question of the kind of nurturing unconcealment that is seen to be forced aside comes as a question of aletheia. In his essay, there is a distinct sense of the danger that the essence of technology poses to human ways of being in the world.

Looking for the “essence of technology” in things like airplanes, mining, and hydroelectric and atomic power, Heidegger asserts, somewhat surprisingly, that this essence is nothing technological. Instead, he finds the essence of technology at work in the advent of modern physics, “almost two centuries before technology” (Heidegger, 1977, p. 21). Approached this way, the essence of technology comes as a calculating and “enframing” power which transforms the objective world into a “standing reserve” of resources for use. In this standing reserve, things are not seen to be what they are (a forest of trees for instance), but become enframed in a kind of logic of productivity (seeing the forest only as a source for timber). The enframing power of technology removes its target from its status as object and reimagines it instead only as something to be reformulated toward another purpose.
While frequently (and not without cause) considered to be the most direct expression of a mode of paranoid technological primitivism (Cass, 1998; Coyne, 2005; Reeves, 2008), Heidegger's essay also provides his clearest appreciation of what technology may offer: an understanding of the kind of danger that the essence of technology poses, and how such danger forces us to question the ways in which truth is revealed. As Heidegger (1977) describes the saving power of technology’s dissolution of the standard metaphysical arrangement of subject and object:

For the saving power lets man see and enter into the highest dignity of his essence. This dignity lies in keeping watch over the unconcealment—and with it, from the first, the concealment—of all coming to presence on this earth. It is precisely in Enframing, which threatens to sweep man away into ordering as the supposed single way of revealing, and so thrusts man into the danger of the surrender of his free essence—it is precisely in this extreme danger that the innermost indestructible belongingness of man within granting may come to light, provided that we, for our part, begin to pay heed to the coming to presence of technology. (p. 32)

The task of this chapter is not to repeat this same movement of Heidegger’s logic as it may be applied to questions of design and big data, but to take up the sociological question that is present in his work: how do the sweeping changes that this level of technological change brings begin to affect human understandings? For us, this is a reflexive question of data analytics and what that means for the work of design in a world in which more and more of our activities are mediated by designed technologies. How do we come to know about the world for which we must design?

**The Question of the Present Method**

The method used here in this acknowledgedly restless chapter is one of distortion and dissemination, and one which aims for the kinds of true understanding that is only possible
through understanding differently, as Gadamer (2004) was quoted intimating in earlier chapters. This comes particularly as we seek to understand the state of technology today through a lens more than a half century old. To look at the questions of interaction design and the uses of large-scale data with Heidegger is only to understand differently. After all, Heidegger never gave his opinion of big data, nor ever traced an ontological view of the Internet. His consideration of modern technology was limited to the technologies previous to the information revolution. As Gianni Vattimo (2004) has pointed out in tracing the rise of a concern for sociological actuality in contemporary philosophy, there is no indication that Heidegger would have anticipated the technological developments found in the Internet and the kinds of distributed communications networks so different from the modes of mass communication possible in his lifetime. In engaging in a reading of his consideration of technology that moves from addressing mechanical technologies toward information and interactive technologies, there is an intentional refraction and reconfiguration of his thought—a distortion and singular gathering together the like of which Heidegger himself was not alien (Derrida, 1989).

The Question Concerning Big Data

In many respects, when considered alongside Heidegger’s “The Question Concerning Technology,” big data initially takes a similar form to that of the essence of technology. This essential view of big data, like that of technology is far removed from a more ontic consideration of data. Just as "[t]echology is not equivalent to the essence of technology" and "the essence of technology is by no means anything technological" (Heidegger, 1977, p. 4), so too can it be said that the essence of big data is not aligned with “data.” The essence of big data is something else. But how should this essence be considered and what are its implications?
The facile reading the question of big data. In beginning to read and consider the implications of Heidegger’s essay together with the present concerns of big data and design, it is worthwhile to first indulge in what I consider to be the most facile reading of the situation possible. This facile reading is one which focuses on the possible negative implications of big data and design as they are considered under the rubric established by Heidegger’s concepts of “enframing” and “standing reserve.” In this, users are taken as standing reserve only to be understood in terms of the data that they are able to produce in service to further data collection. Reduced purely to the data they produce which is used as fodder to support the design of applications, the richness of their being is ignored and they are accounted for only as they are to be of instrumental use. Such would be the case in thinking of the “inauthentic” course discussed in previous chapters. Depending on the tenor of the intended discussion, it would be possible to assert that such uses of big data as standing reserve may serve either nefariously totalitarian or mutually-agreed upon beneficial ends. The data from education could be used to dominate or simply provide “useful” (if inauthentic) services.

As described by Heidegger, the essence of technology changes our relation to revealing and to alethia. In the case of looking at big data rather than technology, under this facile reading so too would the “essence of big data” alter the relation that we have to human activity, even in such a poietic activity as creative design might be understood to be. The mode of accounting—and the value ascribed to such a mode of accounting—replaces more traditional modes of approaching the world; and we become enframed by the impetus for the kind of ratioization found in big data analytics. It is such that we begin to order (through design) the world according to this kind of schema, finally ordering even ourselves. As Willa Cather (1893) put it, satirically responding to early overarching attempts at analytics of her day (Jewell & Pytlík Zillig, 2011):
Ah I counted, Queen, and counted,
And rows of figures massed
Till e'en my days are numbered,
And I'm counted out at last.

—“He Took Analytics”

While this bit of light verse primarily shows why Cather is generally thought of as a novelist and not a poet, it does highlight Heidegger's sense of how enframing unfolds, particularly with respect to the accounting that takes place in big data. It is not simply that analytics—as part of an efficient and totalizing technological system—takes hold of people, fixes them to an accounting table, or uses them in an objective fashion; rather, it is that in the engagement with such systems of accounting, those who engage in the activity itself become inculcated in such way that their very living self becomes subject to such an analytic framing. The accounting of big data becomes the nature of those engaged in the counting. In many ways, this resonates with Foucault's (1994) consideration of the tabled nature of the invention of the subject.

Cather's verse provides the possibility for a reading of this double effect of technological enframing: both that the individual person, as biological organism becomes counted in an analytic fashion, while at the same time, in their counting, they are dealt, as a child counts out playing cards, into the hand of a technological essence. Even their very existence toward death, as fundamental ontology, becomes as ratio.

This facile reading proves to be especially threatening when considering something such as design, with all the implications for the further inscription of such an essence of big data into that which is designed (as per Winner (1980)). Such a snowballing is found “precisely in Enframing, which threatens to sweep man away into ordering as the supposed single way of revealing, and so thrusts man into the danger of the surrender of his free
essence.” (Heidegger, 1977, p. 32). Worse, where Heidegger sees that “it is precisely in this extreme danger that the innermost indestructible belongingness of man within granting may come to light” (p. 32), given big data's sway over the poiesis of the work of design, we are confronted with the possibility that the work of design might no longer be an avenue for the “free essence” of the human, but instead become providence of the accountable essence of big data. In this paranoid reading, even the saving power that Heidegger sees in technology, that it weakens our metaphysical conceptions of the subject and object, allowing us to think other possibilities, is all in vain.

**Reading beyond the facile.** While not out of hand opposed to such a terrifying account of the situation presented by big data, it is necessary here to pause and consider this account of a quasi-metaphysical overtaking of the free essence of the human being by an essence of big data analysis and how the contemporary situation of technology transforms Heidegger’s story.

This understanding of the essence of technology, and its implications, changes when it is considered in light of the development of technologies that followed Heidegger’s 1954 essay. As Vattimo (2004) points out, the kinds of mechanical technologies that Heidegger considers in his essay pose startlingly different questions than the kinds of information technologies that characterize contemporary technology. This is particularly important when considering the kind of saving power that Heidegger sees in technology, as Vattimo points out:

Actually though, if we try to think clearly about how the Ge-Stell [Enframing] might offer us a chance of overcoming metaphysics through the dissolution of the subject-object relationship that distinguishes human existence in modernity, we see that the only apparent solution is a radical shift in our vision of technology. The technology that does actually give us a glimpse of a possible dissolution of the rigid distinction
between subject and object is not the mechanical technology of the motor, with its one-way flow from the center to the periphery, but it might very well be the technology of modern communications, the means by which information is gathered, ordered, and disseminated. To speak more plainly: the possibility of overcoming metaphysics, which Heidegger describes obscurely in the *Ge-Stell*, really opens up only when the technology—at any rate the socially hegemonic technology—ceases to be mechanical and becomes electronic: information and communication technology. (p. 15)

While mechanical technologies (and even now-primitive communication technologies such as radio and television broadcasts) all point (still) to a gathering together of influence and a consolidation of essence, information technologies, with their ability to disseminate information and to open up the possibilities for a weakening of any metaphysical framing point away from a consolidation of essence. “[A]s the systems of information transmission becomes denser, ‘interpretive agencies’ also tend to multiply, and, by a paradoxical logic of autodetermination, these agencies present themselves ever more explicitly as interpretive” (Vattimo, 2004, p. 16-17). Vattimo finds the operative kernel of this thinking in Derrida’s (1981) thinking of the interpretive valences of a text, such as occurs in the technological challenging forward perpetrated in the work of technology. As Derrida puts it:

> It is the sustained, discrete violence of an incision that is not apparent in the thickness of the text, a calculated insemination of the proliferating allogene through which the two texts are transformed, deform each other, contaminate each other's content, tend at times to reject each other, or pass elliptically one into the other and become regenerated in the repetition, along the edges of an *overcast seam*. Each grafted text continues to radiate backwards toward the site of its removal, transforming that, too, as it as it affects the new territory. Each is defined (thought) by the operation and is at
the same time defining (thinking) as far as the rules and effects of the operation are concerned. (p. 355)

In this, the kind of enframing that Heidegger investigates in relation to modern technology finds itself disrupted both in the figure of information technology, but also more fundamentally. What is evident, is that once information technology is considered, the facile reading of big data as a mode of enframing becomes more difficult as it relies (in almost all cases and certainly in the case of design work) on these networks of information technology. If the common negative characterization (Matthewman, 2011) of Heidegger’s thinking about technology is followed, this can be seen as good news: there is a way out of the clutches of the essence of big data analytics. However, in the context of the saving power that is found in the threat of this technological enframing, in the loss of such a threat, the saving power is lost as well. If the danger that the essence of technology presents (out of which springs a saving power that gives clarity to our role of “keeping watch over the unconcealment” (Heidegger, 1977, p. 32)) is neutralized by technology’s development away from mechanization and centrality and toward information and dissemination, how are we to think about big data and the way in which it plays upon the revealing work of design?

**Big Data, Design, And Metaphysics**

The kind of large sets of user data captured in the running of MOOCs, as both the data collection and the MOOCs themselves are part of an information system *par excellence*, are able to play the role that Vattimo sees for technology as that which, though its possibility of circulation, weakens any conception of a staid metaphysics. This is even as the data, in their seemingly neutral and over-arching god’s-eye view of actuality, provide an example of the ideological potential for the kind of technological enframing that Heidegger warns about. Similar to the situation described in chapter 4, in the case of MOOC data, it is not that big
data comes to enframe and hold back any potential uncovering, rather, that the data plays a central role in dynamically thinking-with designers in their work.

As described earlier, this follows the work of Schön (Schön & Bennett, 1996; Schön, 1992) and others (Cardoso, 2009) who point to the reflexive role that the materials of design play in the agentive work of design. As design becomes more dependent on larger-scale considerations of human activity (Norman, 2010), the insights generated from an engagement with big data concerning user activity come to be those materials with which the work of design reflects. However, unlike the traditional or ordinary materials of design (plastics, paints, woods, interfaces, etc.), big data presents materials that, as fitting to their disseminatory origins, are open, mutable, constantly in flux, and, most of all, derived (as discussed in chapter 5) from traces left by the free essences of individuals.

It is in the particular consideration of design and big data that the anti-foundational ontology that Vattimo ascribes to information technology shows itself in a new light, one which is founded upon the concept of progress, change, and dissimulation as its foundation. As Rorty (2007) points out, in his call for nihilistic weakening of metaphysics, Vattimo still cautions against the temptation to erect nihilism into one more metaphysics—one more claim about the one true context in which human lives must be lived. The Internet is a model of weak thinking because everything that appears on it is continually being recontextualized and reinterpreted as new links are added. It is thus a model of human existence as centreless and historically contingent and an example of what Vattimo calls ‘the dissolution of the principle of reality into the manifold of interpretations.’ (p. 156)

This kind of metaphysical freedom needs to be contrasted with some readings of Heidegger’s account of the essence of modern technology which holds that it “is to seek to order
everything so as to achieve more flexibility and efficiency” (Dreyfus, 1993, p. 29). Where information technology begins to distinguish itself from this characterization of “modern” technology is in that the kind of continual flexibility of Internet discourse that it makes possible is no longer wholly linked to or motivated by a call for “the maximum yield at the minimum expense” (Heidegger, 1977, p. 15) as is mechanical technology. Instead, the mode of dissemination found in the “manifold of interpretations” (Vattimo, 2004, p. 20) of information technology escapes the imposition of a particular technological mode of being that seeks flexibility for the sake of efficiency. Nevertheless, information technology still preserves some sense of the continual re-ordering Heidegger worried over. This re-ordering comes very much in the vein of the facile reading: that through the big data of information technology it is possible to establish human beings as standing reserve, ready to be deployed for any purpose. However, instead of calling for “efficiency” and “maximum yield,” this scenario points only to an open-ended flexibility. Information technology presses for the sense of flexibility put forward in the essence of technology, but lacks a similar metaphysical enframing enforcing only a singular and particular mode of unconcealment. Whereas the essence of technology is predicated on a re-ordering for some other purpose, the essence of information technology (and by extension the essence of big data) is predicated only on re-ordering.

**Big Data as an Enframing Progress**

Where Heidegger (1977) saw “[t]he coming to presence of technology” as threatening the kind of revealing of truth found in *aletheia*, “with the possibility that all revealing will be consumed in ordering and that everything will present itself only in the unconcealedness of standing reserve,” (p. 33) a facile reading of “The Question Concerning Technology” in the context of big data seems to present just that: a universal ordering for the world. In the facile reading, the kind of revealing found in big data is still that which challenges forth rather than
allowing the world to reveal itself on its own accord in a poietic movement. In the facile reading, big data is seen to offer an “ordering and that everything will present itself only in the unconcealedness of standing reserve.” While the facile reading seems to too easily elide the changing nature of technology as highlighted by Vattimo, shades of it should nevertheless be considered as being real possibilities. Instead of a standing reserve set aside for the purpose “the maximum yield at the minimum expense” as in the case of the essence of technology, the standing reserve of big data can be seen as being only for the purpose of the furtherance of analytic power itself (Marcinkowski, 2015). However, in the case of the use of big data in the work of interaction design, as design itself serves as a poietic nurturing forward of aletheia, the contemporary relationship between design and large sets of data presents a radically alternate reading of this technological enframing.

Hints toward this alternate reading of technological enframing under the aegis of big data can be seen when considering Werner Callebaut’s (2012) critique of big data under the aegis of scientific perspectivism, specifically as the seemingly neutral and universal vantage point of big data is discarded in favor of a perspectival account. Such a perspectival account of big data lays the groundwork for this new and distinct mode of enframing. As Callebaut puts it, an “important hallmark of perspective is explicit non-commitment” (p. 76). This epistemic “explicit non-commitment” to any one perspective that orients Callebaut’s understanding of the reality of science is set up to provide, as he says quoting Wimsatt (2007), “knowingly incomplete descriptions of the systems to which they are applied.” In the light of the dynamism and velocity presented by big data, it is this openness to (and perhaps encouragement of) “explicit non-commitment” that introduces a new and distinct mode of technological enframing that is seen here. That is, in its constant renewal and refactoring of the picture of a phenomenon that is developed in the data, big data, in its dynamism and velocity, challenges forward in a new and different way.
While in its reliance on networks of information technology (as per Vattimo) big data is able to avoid the specific mode of technological enframing developed by Heidegger, it nevertheless can be seen to establish its own unique analogue. This new enframing goes unrecognized by Vattimo. This is not surprising, especially as the kind of metaphysical weakening that Vattimo attributes to networks of information technology contribute to both the dissolution of Heidegger's model and the instantiation of this new enframing. In asserting that through information technology “ontology is headed toward disintegration” (p. 19) instead of being instituted in a singular form in the wake of the essence of technology, Vattimo (2004) follows the trail of the progressive disintigration of ontology, but does not follow its implications. In focusing so much on the end goal of the weakening of metaphysics, Vattimo skips over the unendingly progressive cause of this weakening, perhaps because it is only becoming evident now under the sign of big data.

The constant re-framing given in big data replaces the governance of a single metaphysics of technology. It comes with a more broadly cast progressive play of *différance* which is seen to provide the grounding for the kind of metaphysics of the truth of Being which Heidegger sees under threat by the charging forth of the essence of technology. As Derrida (1982a) formulates the connection between *différance* and the truth of Being:

In a certain aspect of itself, *différance* is certainly but the historical and epochal unfolding of Being or of the ontological difference. . . . And yet, are not the thought of the meaning or truth of Being, the determination of *différance* as the ontico-ontological difference, difference thought within the horizon of the question of Being, still intrametaphysical effects of *différance*? The unfolding of *différance* is perhaps not solely the truth of Being, or of the epochality of Being. Perhaps we must attempt to think this unheard-of thought, this silent tracing. . . . Since Being has never had a “meaning,” has never been thought or said as such, except by dissimulating itself in
beings, then *différance*, in a certain and very strange way, (is) “older” that the ontological difference or than the truth of Being. When it has this age it can be called the play of the trace. The play of a trace which no longer belongs to the horizon of Being, but whose play transports and encloses the meaning of Being: the play of the trace. The play of a trace which no longer belongs to the horizon of Being, but whose play transports and encloses the meaning of Being: the play of the trace, or the *différance*, which has no meaning and which is not. . . . There is no maintaining, and no depth to, this bottomless chessboard on which Being is put into play. (p. 22)

What is given in the “velocity” of big data is just this: the constant shifting of pre-metaphysical (un)grounding on which varieties of the unconcealment of Being (both human and technological) can find root. The progressive charging forward of big data forces a constant re-evaluation of this “bottomless chessboard” from which the truth of Being is nurtured (as in the picture of *aletheia*). As in Derrida’s consideration of dissemination, this movement of free play engendered by information technology gives root to the same ponderous revealing that Heidegger (1977) suggests as mode of revealing “fundamentally different from” (p. 35) technological challenging forth: *poiesis*. It is within this unique formulation of the constant and progressive enframement driven by big data that the situation of design is presented.

**Big Data and the Situation of Design**

In its ever-renewing play of *différance*, big data provides the situation for design as it exists in the present or at least *some* presents. What is key in the consideration the situation established for the work of design (a consideration which recalls previous discussions of design in chapters 3 and 4) is the ever-expanding picture of the present that big data provides. There is always new data and always more data. While this picture of the continual change of technology, particularly as it relates to interaction design and the developing and recursive
setting of its use, is nothing new, big data, in its vastness and ability in this vastness to perform this circumscribing function of setting up the situation of design, provides the kind of ontological view that comes to sustain the work of design. As previously discussed, this sustaining comes in the manner of providing the material which sustains and enables the reflective work of design. This use of big data in the work of design has been termed “thinking-with” the data. This material comes to designers across the event of the happening of the data (as in the critical incidents developed in the last chapter). As Vattimo (2004) discusses the postmodern situation of technological ontology:

Because there is no way to grasp Being as something stable apart from its event (this is, the specific historical aperture in which it arises by allowing beings to appear), a theory of present existence is a theory that has no other source of information or legitimation apart from the present condition itself (p. 8).

In this, big data is set up to provide the initial access to the presencing of Being that is uncovered in the work of design. It provides materials for design, and design elucidates those materials through a process of poietic uncovering.

This contrasts with Heidegger's (1977) mechanistic (non-informational) view of technology:

The revealing that rules throughout modern technology has the character of a setting-upon, in the sense of a challenging-forth. That challenging happens in that the energy concealed in nature is unlocked, what is unlocked is transformed, what is transformed is stored up, what is stored up is, in turn, distributed, and what is distributed is switched about ever anew. Unlocking, transforming, storing, distributing, and switching about are ways of revealing. But the revealing never simply comes to an end. Neither does it run off into the indeterminate. The revealing reveals to itself its own manifoldly interlocking paths, through regulating their course. This regulating
itself is, for its part, everywhere secured. Regulating and securing even become the chief characteristics of the challenging revealing. (p. 16)

For Heidegger, in the enframing of the essence of technology, there is a concern for the regulation of this “challenging revealing.” In light of information technology as discussed by Vattimo, and the weakening of any metaphysical structures that seek to regulate the kind of enframing that Heidegger discusses, the character of this kind of challenging revealing is altered and the level of analysis descends to a more fundamental (un)grounding. The rush of the dissimulation of différance which lends its logic to the rush of big data ensures the continuance of the challenging revealing, but in such a radical form that any regulation (as onto-metaphysical position) is weakened in the process. It is that in the big data mode of challenging revealing, what is challenged forward is an unregulated revealing.

If we follow the negative threads laid by Heidegger, the contemporary situation of big data and information technology enframes not in any regulatory manner (as exemplified in Heidegger's use of the cluster of terms derived from “stellen” in the German text), but instead in a manner that challenges forward a poietic revealing. The kind of “[r]egulating and securing” (p. 16) that Heidegger (1977) discusses as the enframing that leads to the development of a standing reserve are replaced in favor of a compulsion to activity and change. Big data challenges the work of design forward not in the same manner as might technology challenge it forward, but in a manner which lets design stand forth.

**Interlude**

To pause here and to draw out what has been discussed above in necessarily abstract terms, what comes to be seen in the figure of big data is an injunction toward constant movement in the work of design. Whereas Heidegger's picture of (mechanical) technology would say, “act in this way (of regulated challenging revealing),” big data simple calls out: “act.” For understanding design, this compulsion to act is one which is linked to what are
normally understood as positive characterizations of human activity: productivity, creativity, innovation, etc. In providing the social insight into user behavior which is used as material in the work of contemporary interaction design, big data provides the situation for the work of design in the form of a never ending stream of new contexts that must be addressed. There is always more to design.

This is, of course, in many ways, the existant situation even previous to the rise of big data (Carroll et al., 1991). There was always a new situation of design, and always more to design. The difference, one that will be explored as this chapter continues, is that which is explicated forcefully by Heidegger in the permanence of the enframing. In the constant dissolution of metaphysics, we are challenged forward in a heretofore unknown manner. Design is cast no longer as a choice, but an obligation. In this Heideggerian rendering, the implications of this difference and the obligation it presents have import for the engaged constitution of Being in line with that as developed by Emmanuel Levinas (1969): that which is constituted in the ethical call put forward by the possibility of something radically other, a phrasing which should remind us of Aristotle's (1998) definition of τέχνη as a virtue concerned with “contriving and considering how something may come into being which is capable of either being or not being, and whose origin is in the maker and not in the thing made” (p. 141). As such, it could be possible to render a re-reading of chapter 3 in these terms, one which would lay out the doubly ethical ontological movement of design work in terms of big data's metaphysical rushing. Such a line of thinking, however, must be set aside here in favor of following the question of design in an era of big data and its site of cause and intention.
II

Will and Knowing

In order to understand this challenging forward of the play of *différance* found in big data, it is necessary to examine the “presenceing” that occurs in the conjunction of big data and design. This examination will give shape to the understanding of the work of design that is developed. At bottom, what is to be developed is an understanding of the engagement of a traditionally-located agency of design within a field of ever-progressing and charging forth *différance*. What flowers from big data bursts forth from its own accord while at the same time from in another. This is characterized by the thinking-with the data in design.

The Intention of Will

Looking to diagnose the internal function of the *thinking-with* of the rushing forward of big data in the work of design, it is necessary to consider the relationship between knowing and the question of will, particularly as this relationship can be seen as the locus of Herbert Simon's (1969) conception of the “preferred” situation toward which the work of design is aimed. In order to address this question in a manner that will also be of use to understanding the kinds of interpretive questions are faced in the use of big data when it is applied to the question of design, it is useful to examine the role of “will” as it can be understood as motivating the work of interpretation. Such a consideration applies to both (in a reflexive mode) this present interpretation of Heidegger's essay, as well as to the understanding of the function of interpretation of big data that takes place in the work of design.

This question of will finds its locus and a kind of territorial definition in an encounter between Gadamer and Derrida (Michelfelder & Palmer, 1989) in which they sought to consider their respective approaches, hermeneutics and deconstruction, within a common frame. Each can be seen as inheriting a certain version of the tradition of philosophy as
passed down from Heidegger, and each takes the role of “will” in understanding to be different. Writing about this distinction between the two, Josef Simon (1989) states that, in following Heidegger, for Gadamer

philosophy and its history want “to bring 'the speculative' to presentation,” but Heidegger, however (also according to Gadamer), based on “insight into the central significance of finitude,” has taught us that this can only be an “endeavor,” a “constant challenge,” that is, a matter of “good will,” so to speak. (p. 163)

Which is to say that there is an aspect of the eternal and never-ending in the work of understanding and interpretation. For Gadamer, there is a central role for a good will to understand to play in the kind of inter- subjective dialogue that can bring about a shared understanding. In some many ways, this “constant challenge” fits with his student Vattimo's work surrounding the weakening of metaphysics around the question of information technology. Derrida, however,

interprets the “Will to Power” quite differently, namely, as a counterconcept to the concept of a commensurate and therefor true understanding. If everything is will to power, then all understanding is will to power. It wills to bring itself to bear precisely in its seeking to understand. It wills to annex, to appropriate the other. The sensible "good will" to reach a commensurate understanding is, in Derrida's view, really only a delusion, eventually a self-delusion. (J. Simon, 1989, p. 165)

That the willful act of understanding serves to distort any sense of originary meaning that is to be found is not something that is lost on Gadamer (Gadamer, 1989), as he puts it:

The fact that a poetic text can so touch someone that one ends up “entering” into it and recognizing oneself in it, assumes neither harmonious agreement nor self-confirmation. One must lose oneself in order to find oneself. I believe I am not very
far from Derrida when I stress that one never knows in advance what one will find oneself to be. (p.57)

Between the two thinkers, there can be no singular binary distinction and each presents a version (and here it is possible to see Vattimo as the link between the two) of the weakening of metaphysics that is found in the constant shuffle of big data, with Gadamer presenting the hope of some possibility of solidity, with Derrida only refuting it as evidenced by the very assertion.

The question of will in the work of design (even outside of the purview of big data) comes to be, in a functional sense, considered as balancing between the two thematic poles. This has been seen empirically in the analysis of the MOOC forum data. Both students and the designers illustrate these valences. On the one hand, the designers and instructors set out in a willful manner in order to “annex” and “appropriate the other” in their selective (and sometimes seemingly arbitrary) consideration of the feedback from users. At the same time, however, they work to simultaneously present their vision of the course to students and work to ensure that they are able to understand whether or not students are learning in the course.

The interpretive valence between the good will of Gadamer and the will to power of Derrida serves as a figure which provides added definition to the picture of poietic revelation on the part of Heidegger in his discussions of clearing toward Aletheia. In the situation of design and big data, there is an interplay between these two valences of will: On the one hand, designers seek to approach the heterogeneous clearing of big data in a welcoming fashion, looking to understand and be understood. On the other, it is possible to, in a willful manner, force the heterogeneity presented in big data into a unified picture, with "a single system of reading is powerfully concentrated and gathered together" (Derrida, 1989, p. 58).

In these poles of the possibility of interpretation comes the incident of the thinking-with of design.
Design Knowing and Doing

The picture of big data and design that is being developed here presses big data and design together. As already detailed, this can be considered in the general sense of thinking-with. The work of design today, in the ubiquity, pervasiveness, and embeddedness of computing in our everyday lives, has come to be concerned with data as both the material of design and its defining situation. Flows of data come to define how human users confront use and is the medium by which designers can understand their users. The kind of epistemic picture that big data provides for designers is bound up in their work. While the level of such engagement is unprecedented, the connection between the kind of knowing that comes through data and technical work is not a wholly new development. As Heidegger (1977) notes:

> From earliest times until Plato the word techne is linked with the word episteme. Both words are names for knowing in the widest sense. They mean to be entirely at home in something, to understand and be expert in it. Such knowing provides an opening up. As an opening up it is a revealing. (p. 13)

In this, the technical kind of making that design might be considered as is concerned with both a knowing and a doing. The connection is drawn between the sort of “knowing of” or “knowing about” found in episteme as contrasted with the “knowing how” of technical craft.

In contemporary interaction design, these two senses are merged in a manner that is most overtly seen, perhaps only able to be fully recognized, under current conditions of big data analytics. That is, contemporary interaction design is fundamentally concerned with the confluence of “knowing of” and “knowing how.” The division between the two is most clear in the example of the technically skilled designer who knows nothing of the domain within which they are designing. The often-cited example of the design of an aircraft control system (Bentley et al., 1992) proves the point well. There, designers envisioned a technically
accomplished system, but without insight into the situation for which it was being designed. The “know-how” was not supported by their “knowledge-of” the situation.

As laid out in chapters 2 and 3, the lesson of human centered design over the last 50-plus years has been just this: the design must work within its intended situation. In this, the work of any particular designer responding to any particular set of circumstances (circumstances which may be in constant flux in their relation to the object of design (Carroll et al., 1991)) is just that: particular. The immediate and particular value of any work of design is limited to the immediate social and user-centered conditions of use. In such a case, given the particularity to which a design is addressed, design is “completed” by the shifting and developing conditions of use that come about as users engage the design system in response to their own particular conditions. In the case of design in the context of large-scale data, this completion of the work of design is reflected in the data collected. In light of the thinking-with of design in the context of large scale data, the completion of design in use comes to play a direct role in the work of design.

Considering the epistemic relationship between “knowing how” and “knowing of,” the conditions established by big data impact the work of design in two distinct ways. These ways build upon characterizations of the work of design in the era of big data described in chapters 3 and 4. First and most directly, in the rushing forward of big data as developed earlier in this chapter, there is an ever-shifting relationship between the work of design and the situation of design. Such a dislocation has long been present (Ackerman, 2000), but it is now present in a manner which makes the shifting environment of use both painfully evident and painfully available. Second, unlike a more isolated system (such as even something as dramatically broad and widely integrated as air craft control, which, while certainly complex, is explicitly limited to a certain function), contemporary large scale online systems (such as MOOCs) come to rely on big data sets of interaction data in order to facilitate the social-
material interaction on which they depend for their function. In the case of large scale socio-
technical design, the “knowing of” and “knowing how” collapse into a single data set, one 
which presents the ever-developing conditions of design and use.

In the situation of big data, the work of design reveals in a recursive manner, with 
design, with its active thinking-with the data, drawing out (unconcealing) the truth of the 
situation as presented in the data, with the resulting use of the product of design in turn 
generating more data. Navigating between a forcing of will and an openness of legitimate 
mutual understanding, this mode design which recursively presses forward disrupts the break 
that is reasoned between an enframing metaphysics and no metaphysics at all. The thinking-
with of the work of design with data which describes the situation of use utilizes these 
metaphysical structures of use (as found in the data) against the very same structures in the 
changing and progressive work of design. This follows Vattimo’s (2004) general program of 
weakening metaphysics: “Thought prepares the overcoming of metaphysics only by 
responding to a call from within the very situation that must be overcome” (p. 12).

For the work of design, big data has come to define the situation which it must 
overcome in order to move from the situation of the present to a preferred one. The 
interaction of design and large scale user data presents a constant over-coming and 
reestablishment of a series of metaphysical framings. In this rapid switching, even if each 
moment of unconcealment in design comes as poiesis, it is not necessarily a revealing that 
lasts. In the field of socio-technical activity in the face of large scale data, there comes to be a 
constant shifting to a new situation of design. As the inverse of a film projector, it is the 
blankness that exists between each clearing that comes to characterize a new metaphysics of 
progress.
The Cause of Design

So far, the rushing-forward of the thinking-with of design and data has been bounded across two dimensions: first between the active positions of a will to understand and a will to power and second between the epistemic positions of knowing how and knowing of. In this, the resulting picture of the rapid flux in the field of action in design is well on its way to being delineated. What remains to be considered is the way in which an individual designer may exert their will of the nurturing forward of design (either as good will or will to power) within a setting of dynamic metaphysical enframement as defined by big data. In engaging this question of enframement within the perspective of the question of agency, there is a turn to salvage some of the essence of Heidegger’s pessimistic message concerning the relationship between cause and technology.

To do this, it is necessary to look back to the way that Heidegger (1977) sees that “[t]he modern physical theory of nature prepares the way first not simply for technology but for the essence of modern technology” (p. 22). In this, physics is presented “as pure theory” which “sets nature up to exhibit itself as a coherence of forces calculable in advance,” and “therefore orders its experiments precisely for the purpose of asking whether and how nature reports itself when set up in this way” (p. 21). This is, of course, reminiscent of Ian Hacking’s (1982) quoting of Francis Bacon as discussed in chapter 5 (“when by art and the hand of man she is forced out of her natural state, and squeezed and moulded”). Here, what is central to Heidegger can also be seen as being central to certain caricatured (i.e. (Anderson, 2008)) concerns of big data: “that nature reports itself in some way or other that is identifiable through calculation and that it remains orderable as a system of information” (Heidegger, 1977, p. 23). This mode of calculation is key for understanding the essence of technology, and at first blush seems to be important to understanding what is at stake with big data—that human activities and descriptions of use are reduced to a pure calculation. Here, it is easy to
turn again to a facile reading of big data, seeing big data as a means of totalizing control that works toward the pre-ordering of nature and human-computer interactions. However, what is of interest here is not any discussion of science or the grounding of Heidegger’s thinking of the essence of technology, but rather the way that such thinking begins to tell the story of a certain kind of understanding of causality and locus of activity in the process of design.

What Heidegger (1977) introduces in his discussion of the roots of the essence of technology in science is a consideration of the way in which such ordering comes to be understood as cause:

Causality now displays neither the character of the occasioning that brings forth nor the nature of the causa efficiens, let alone that of the causa formalis. It seems as though causality is shrinking into a reporting—a reporting challenged forth—of standing-reserves that must be guaranteed either simultaneously or in sequence. (p. 23)

Instead of reading Heidegger here in his critique of the kind of cause seen in an enframing challenging forth of the essence of technology, we should read it in light of the developed picture of a poietic challenging forth that is seen as big data enjoins designers to themselves press forward in their work of unconcealment.

This reading shifts any active work of design away from the designer (who would be considered the causa efficiens, as that person doing the making), and toward the data itself. The data collected about users, as it is continually replenished, updated, and expanded, comes to direct the forms and purposes of applications, more than the work of any individual designer. It itself becomes the arbiter of what truthfully is. The designer comes to play, as per Kierkegaard's (1987) reading of Socrates, role of mid-wife, not being responsible for the birthing of the design, but, as the locus of a poietic revealing—the raconteur who does not make any decisive claims for the truth, but instead allows what is in the data to be born out.
In leading the creative work of design forward, it is possible to see the system of data and design as letting “what is not yet present arrive into presencing” (p. 10,), an act which Heidegger (1977), quoting from Plato's *Symposium*, ascribes to poiesis: “Every occasion for whatever passes over and goes forward into presencing from that which is not presencing is poiesis, is bringing-forth” (p. 10). It is with the discussion of poiesis, however, that Heidegger's (1977) insight into the nature of cause becomes radicalized, opening the possibility of the bringing-forth characterized by poiesis to also provide a model for physis [nature] which contrasts with poiesis in that

(for what presences by means of physis has the bursting open belonging to bringing-forth, e.g., the bursting of a blossom into bloom, in itself (en heautoi). In contrast, what is brought forth by the artisan or the artist, e.g., the silver chalice, has the bursting open belonging to bringing-forth not in itself, but in another (en alloi), in the craftsman or artist. (p. 10-11)

This distinction between that which “is brought forth by the artisan” and that which “has the bursting open belonging to bringing forth . . . in itself” is complicated by the double movement of poiesis in both design and its situation driven forward by big data. This complication will lead us to question the possibility of setting the work of the artisan (in our case, the designer) apart from the situation of the work, resulting in a poiesis which comes to appear as physis. As in chapter 4, the responsibility for the revealing of design is shared between the data and the work of design itself.

Together, big data and design come to establish a clear picture of the kind of anti-humanist understanding of a poiesis which functions together with physis. At the root of the kind of phenomenological investigation present here (which finds some root with Heidegger’s split from Husserl) is the question of how we, human beings, are able to have any knowledge of the world outside of a knowledge refracted in our own practices. What big
data creates, in its perceptive eye on users, is an overarching account (or at least one facet of such an account) of users’ approach to the world. It is this background, a naturalized subjectivity, that designers engage with in the practice of design and in their poiesis in a manner which slides along in revealing as to match that of physis. Design does not come to be a drawing out, and becomes further removed even from the kind of challenging forth which Heidegger speaks of. Instead, as it thinks with big data in its work, the dissematory poiesis of big data opens itself up to the interpolations of the work of design. Even as they take place within human subjectivity, together, design and big data serve to orient poiesis as a non-subjective physis. While thinking design wholly within the artificial situation and materials presented by big data is not something that can be sustained, as Althusser would say, “in the last instance” when confronted with the actuality of human activity, within their own conditions, design and big data come to present an image of the work of design as something apart from human activity.

In the valence that design and data together open up between the manners of cause of physis and poiesis, it is possible to begin to chart to a-subjective and post-human consideration of design that is developed here. This is not, however, to say that the question of subjective will or desire does not play a part, rather that this is only one part within a wider field. As design comes to “think with” the data in the contemporary work of design, this question of will comes to play a central role.

Here, we follow Heidegger's (1977) claim that this revealing does not “happen somewhere beyond all human doing” but yet “neither does it happen exclusively in man, or decisively through man” (p. 24). We elevate Heidegger's sense of “destining” in place of enframing, flattening the distinction between the challenging-forth of enframing and poiesis, and between the forms given by physis and poiesis. In the realm of design, big data comes as nature and world, as that which destines the poiestic work of design. Against Heidegger, who
says that “destining is never a fate that compels” (p. 25), in its relation to design, big data does indeed compel, even as it may not be fully directed.

With this compelling, we move from a more appreciative reading of technology as made possible by Vattimo and his understanding of information technology, and take a darker turn. That even in the poietic revealing of the work of design, once it is linked to the rushing flow of big data, it itself becomes unfreedom as the revealing movement of poiesis itself becomes compelled, and no longer functions according the schema put forward by Heidegger (1977):

The essence of freedom is originally not connected with the will or even with the causality of human willing.

Freedom governs the open in the sense of the cleared and lighted up, i.e., of the revealed. It is to the happening of revealing, i.e., of truth, that freedom stands in the closest and most intimate kinship. All revealing belongs within a harboring and a concealing. But that which frees—the mystery—is concealed and always concealing itself. All revealing comes out of the open, goes into the open, and brings into the open. The freedom of the open consists neither in unfettered arbitrariness nor in the constraint of mere laws. Freedom is that which conceals in a way that opens to light, in whose clearing there shimmers that veil that covers what comes to presence of all truth and lets the veil appear as what veils. Freedom is the realm of the destining that at any given time starts a revealing upon its way. (p. 25)

It is this sense of freedom that becomes compelled in big data, with the poiesis of design being dragged on behind. In design, once big data is involved, it is no longer possible to manipulate the veil in the work of design, of revealing some specific truth in the work as the covering is already pushed back in the data. Big data points to that which it has unconcealed and commands designers to reveal what has already been shown. This is a loss of both this
fundamental sense of freedom as well as a loss of the kind that is “connected with the will or even with the causality of human willing” (Heidegger, 1977, p. 25). As the data points, so the designers are made to go, with the former freedom that conceals and reveals even taken over by the already-poietic challenging forth of big data. The bleakness presented in this is one distinct from the kind of bleakness that can be found in Heidegger’s approach to technology. Where Heidegger sees the possibility for the recognition of a certain kind of cautionary tale in the essence of technology which can open our eyes to the world and the need to watch carefully over revealing, the danger that comes to be posed for the work of design in big data does not present any such story. The results of big data for design appear as though they are thoroughly positive. There is no threat within which a saving power grows.

In becoming cause itself, or at least manipulating and destining cause and pressing it forward, the phenomenon of big data presents something else, which presses the for the loss any understanding of “a cause-effect coherence” (Heidegger, 1977, p. 26). When used in the work of design, big data seems not to only present, but to fulfill the “supreme danger” found in technology:

As soon as what is unconcealed no longer concerns man even as object, but does so, rather, exclusively as standing-reserve, and man in the midst of objectlessness is nothing but the orderer of the standing-reserve, then he comes to the very brink of it precipitous fall; that is, he comes to the point where he himself will have to be taken as standing-reserve. Meanwhile man, precisely as the one so threatened, exalts himself to the posture of lord of the earth. In this way the impression comes to prevail that everything man encounters exists only insofar as it is his construct. This illusion gives rise in turn to one final delusion: It seems as though man everywhere and always encounters only himself. (p. 26-27)
While, following Vattimo’s critique, it does not seem as if the warning over human beings being “taken as standing reserve” is the ultimate outcome of technology (even as it could be read in the facile reading of design and big data), there is, when thinking of interaction design, certainly a delusion of seeing oneself as “lord of the earth” and of “man everywhere and always encounter[ing] only himself.” Such is the rendering of the function of big data as it engages the metaphor of *Das Man*: we are held within a consideration of who we are, ontically, rather than in the light of the brimming possibility of *Dasein*.

In some respects, it could be argued that this is not a bad outcome, and is, in fact, the goal of any program of user-centered design. We should be “lords of the earth” and should only encounter ourselves in any kind of user-centered paradigm. Yet, it is possible to see some danger in such a conception of design (Garrety & Badham, 2004; Norman, 2005)? In following user data to guide the work of design, what is the line between using empirical insight to guide design work and the kind of innovative thinking that it to occur as we look toward finding what are preferred situations and genuinely new arrangements for computing? As the question has already in one way phrased: when is the implication not to design (Baumer & Silberman, 2011)? The danger which exists is that in seeing ourselves everywhere, every answer comes to be “design.”

**No Longer Ourselves**

In coming to understand big data as playing a decisive role in the cause of design, we can begin to see these things for what they are and to really think about what big data reveals to us about the work of design. Big data and design are coupled in the place that they each hold in contemporary society, with the headlong rush of velocity of more and bigger data pushing designers to continue to design and compelling them toward that which must be *poietically* revealed in their work. What is evident is that with big data and the exceptional volume, velocity, and variety that it poses (Laney, 2001), the relation that data and the space
of design share in the causal work of design is turned to find the emphasis placed on the data. Our very human actions of the kind of *poietic* revealing that characterizes the work of design come to be compelled forward by the flows of data. Instead of being falling prey to the challenging forth of the enframing of technology, we are prey to our own best natures which have been taken over by the rush of data which compels and directs our own *poietic* actions in design.

In this, big data is understood, above and beyond any human action, as the cause of design today in those situations in which big data is utilized. By defining the terms of what may be revealed or concealed in the work of design, the rushes of data that exist outside of any singular control determine the outcome for any work of design: whether it is to come into being or whether it succeeds or fails.

Such insights, of course, are all writ small into only the fields of big data and design and are not immediately compelled to an overarching sociological analysis in the manner in which Heidegger approached the question of technology. However, as with technology in general, there is, at present, some outsized influence exerted, particularly as it comes reflected out of our current pervasive uses of technology. Nevertheless, such insight as developed here is, at present, limited only to the territories already given to the province of big data and interaction design.

The larger insight comes in the sketching out of a field of design as characterized by a constancy of action, of the constant making and seeing of the present moment. In many regards, this constancy seems to swallow up (in the post-humanist perspective given in “destining”) the fundamental conditions of decision that are, under ideal circumstances, thought to give some texture to our work, both as designers and researchers. These points of decision are instead, in the manner laid out above, glossed over, forced out of our hands and given over to the anonymous “user” whose ever-developing data-developed profile is peered
at and prodded into shape. It looms over us, some Big Other of desire or some *Das Man* of possible intelligibility.

If it is to be found at all, this is where the danger comes, in this kind of ethical reduction in the face of big data. That the eternal of *poiesis* is swept up and covered over by a rushing *episteme* without concern for any mode of ethical reflection. Here, ethical is not most associated with what could be considered the traditional province of “ethics” in design (privacy, values, gender or ethnic disparity), but a more fundamental question of an Aristotelian ethical decision of what should be done in order to live a good life. In part, traditional veins of ethical discussions are positive symptom that some concern still bears on. But these are largely lost, if the data does not show their way.

**Discussion**

This restructuring of Heidegger's sociological considerations of the effects of the rise of technology in the light of big data serves to reconfigure our relation to Heidegger's “The Question Concerning Technology,” altering its meanings and conclusions in order to restart a phenomenological consideration of contemporary technology. Through this re-reading, an understanding of the dynamic metaphysical conditions present in the work of interaction design as it is informed by big data are detailed. At bottom, the implications are three-fold: First, the criteria for the veridiction of the design of interactive technology is put forward as a criteria based on the nature of the work of design as engaging in a mode of *alethia*. This *alethia* comes through the human work of the drawing forward and making manifest some aspect of Being. Second, following Vattimo's reading of Heidegger's relationship to modern information technology, the metaphysical enframing of technology is reconsidered in the light of big data as engendering a rushing forward of a constant metaphysical transformation. In this, the *poietic* work of design as *alethia* is preserved, though the field of its action is given over to the metaphysical rushing of the data. Third, the conditions of interpretive will
are considered, with the bond between “knowing-how” and “knowing-of” being linked in the work of design. With this, the darker implications for big data begin to show themselves, as the influence of the data comes to overwhelm any individual human decision.

While ultimately the “danger” posed by the metaphysical and agentive re-rendering of the work of design in the service of big data comes to bear some resemblance to the technological danger proffered by Heidegger, it differs in two dramatic ways. First, the danger posed by big data, at this point and under this analysis, only has implications for the future of the work of technology and interaction design. It does not have a bearing on the wider conditions of Being, outside of the kind of influence which operates through mimetic and not direct processes. That is, we may habitually begin approaching the world in a manner similar to the ways we engage with the work of design, but this is only an indirect possibility and not an ontologically present one. Second, with this limited sphere of “danger,” there is no saving power as Heidegger had proffered with the revelation of recognition of Being offered by the existential danger he saw posed by technology.

More than anything, this analysis speaks to the developing picture of progress and change that is forced forward in the utilization of large, dynamic, and varied sets of data. Whereas Vattimo looks toward information technology as being a boon to the dissolution of the kind of enframing metaphysics Heidegger warns against, the picture that develops when considering big data as a form of information technology is one in which the danger of a staid enframing metaphysics is replaced by one that forces forward a human poiesis of technological action. The danger is not that we will be taken as standing reserve, but that we are, within this technological sphere, always forced into action. This is evident even in a surface analysis of the rhetoric and purpose given to big data: more data will always continue to make things better. The option that had existed to not design is diminished in the face of big data.
What is laid out in this reading is a rendering the field of action that big data constructs within a wider field of technological action. Just as mechanized technology is, at its root and moment of initial founding, a mode of *poiesis*, so too is the establishment of the field of action of big data, in its initial form, also established through a movement of *poiesis*. As the essence of technology for Heidegger is nothing technological, but rather a challenging forth of enframing, the essence of big data comes not in the mode of data analysis that it encourages, but in its pressing forward of the possibilities of *alethia*.

Through all of this, the ethical themes of design as developed in earlier chapters remain central. In transforming Heidegger's critical view of technology into a view which becomes critical of the essence of large scale data, the ethical call of the event of design becomes both clouded and more important. Even as the agentive centering of the *alethia* of the work of design becomes spread across the entire system of design, use, and the flows of data that connect the two, there remains, in the opening set forward by the situation of design (as detailed in the case of MOOCs in the typology of critical incidents), a moment of absolute ethical decision on the part of the designer. What becomes added with this consideration of big data is an additional imperative to the question of this ethics of design. The question of ethics is no longer one which is asked in a casual fashion as when a designer might be confronted with the question of how they should design a bridge, for instance. In designing a bridge, the situation confronted in the consideration of the purposes of and needs for a bridge does not necessarily change, at least not rapidly. There, a designer may consider the answer for some time, with the agency of the timing of the decision left largely to them. In the context of large scale data and the rapid iteration possible in interaction design however, the rushing forward of user data presents an ever-changing situation of design. Faced with this ever-changing situation, designers are forced to continually confront the ethical question of what to design in any given situation. This constant rushing forward of the
ethics of design has a two pronged effect: it both dulls our senses to any concern of ethics in particular and covers over the wider ethical issue of whether to design in the first place. The anchor of ethics in design becomes unmoored in the face of the rushing torrents of data.

The pressing forward of the rush of data presents a situation that is more than metaphysically-dynamic than that presented in “The Question Concerning Technology.” In this, any straightforward reading of Heidegger becomes wrecked on the shoals of the frontier of big data and the hand that such data has in the continued design of the socio-technical systems in which we live. As throughout, Heidegger's thinking concerning technology remains an important antecedent to sociological and philosophical considerations of the implications of technology, but its ultimate value is circumscribed (as in Vattimo's critique) by its distance from more advanced technologies. After all, technologies change. “What does not change,” however, as Charles Olson (1966) wrote, “is the will the change” (p. 167).
Imagine an aerial view of wind blowing over a cornfield. The stalks sway in the eddying breezes making patterns appear and then vanish in the ripples of green and gold. Textures rise out of the rows and fall back. It's not possible to say which of the stalks or which particular gust might be responsible for any particular pattern or texture, but what is certain is that they are all playing some role. The overarching view of the waves of the field are abstracted from any any of the particular conditions present. The textures of the field come into being as if in order to fall away.

Held within the present era of big data, the work of large-scale socio-technical design is likewise situated as an abstract field of ever-changing possibilities. The pathways and meanings that surround the question of use are expanded and left open to the potentialities presented in the data. Patterns arise and fall away, in part as a course of things, in part from the particulars of the attention given to any part of the field at any moment. Technological affordances come into being, support behaviors, only to fall away again, all against the field of user data and the historical traditions available.

Designers, users, and the data by which they are abstracted and thought with all play a part and all contribute to this picture. The specific work of design comes in the grooming and planting of the field. As it is set within the wider field, this grooming and reaping is a never ending proposition reliant on a never-ending series of dependencies: the soil, seeds, winds, rain, cloud cover, the sun, insects, birds, threshers, market prices, dietary fashions, scientific knowledge, genetic engineering, moral values . . . it would be possible to go on forever listing the things which, in whatever slight and seemingly arbitrary way, impact he eventual working of the field. Cast in the light of hermeneutics, the work of design is always to understand the situation of use differently, to always understand this transitory difference in
the situation of use differently, to account for the entire field of possible historical interactions. *Différance* points to the always deferred networks of dependencies through which meanings develop. The engagement and relationship that exists between designers and users is the epistemic thread that links the possibilities of the recognition of the field of action and the willful intention of the shaping of this field by designers and users. In their role in this mediation, volumes of data come to define the work of design, doing so actively—in their taking up and reflecting the wills and needs of users—and passively—in their interpretation at the hands of designers. These valences have been shown in both the development of the thinking-with of the tool of data and the critical incidents that mark out the historical field of action. The *general* work of design can be found in this span of the total action across the field.

This is only one imperfect metaphor among many, with metaphor failing at its point of reflexive reference (Derrida, 1982b). For understanding design under the rubric of information science, this point of reference comes across any number of localities (M. J. Bates, 1999; Bawden, 2008). The question of metaphor is where to stop and where to attempt to insert the incisive dislocation that points away from one metaphor and toward another.

This research started with the question of the (metaphoric?) relationship and the dialogic exchange that occurs between users and designers. Mediated through the data, this relationship comes less as one of a singular structured intelligibility, of designers and users coming to any stable sense of the function of design or use, as does the relationship of intelligibility rely on a progressive and continuing relationship. This as the relationship is founded in the continuous field of data. It is a relationship that exists as the fact of use, with what has been developed over the past five chapters laying out the terms of this relationship in various ways and from varying perspectives. In this, designers and users are understood to be brought together by nothing other than the sheer fact of their relation.
In the kind of coupling that exists between users and designers, helped together in the mediation of data, it is only this bare fact of the relationship that seems to matter. On each end, the interpretive valences possible in processes of data analysis and use leave open the articulation of the joint on either end of this coupling. Harbored within a wider field of material and historical socio-technical action, these articulations are moved and stretched and strained in new and unexpected ways.

What comes to matter, beyond the individual relationship, is the volume of the data that is at work in building up and sustaining this relationship. Whether from individual users or masses of users, when confronted with sources of data of sufficient size, the terms of this relation change and offer up different modes of insight and influence, modes which can only be recognized through the engagement of the work of design. The fact of the relationship and the terms that make it possible come to bear their influence on the total system of the work of design. Designers design to the terms of the relationship, with users likewise using under the aegis of the offered design. The relationship becomes a fact in the way in which the relationship is conducted. The sheer fact of the relationship, as *Mitdasein*, provides the fulcrum of the existence of the act of design.

Through these mediated relationships, designers and users come together to contribute to and to realize the future of the object of their design (isn't this the rhetoric of a thousand beta testing programs?). The scale of the user data that designers are able to think-with in their process of design are such that they (here ironically invoking the English translation of *Das Man*) make present and publicly available the existence of the otherwise invisible reality of the socially-conditioned terms and practices of use. As the work of design is directed through material means toward the immaterial conditions of use, it is the data that makes the object of use and design mutually present.
In the distillation of the typology of critical incidents, the relationship between design and use, analysis and system, and beyond are given reified form, with the data giving structure to the otherwise immaterial of the performance of the course. The moments of these engaged relationships and the breakdowns that are laid out in relief against normal use, provide a view into the ontic shaping of the total system—a view which stands apart from any particular centering. The accidents and errors which motivate the continuing reevaluation and change of the system are laid out so that, in a moment of reflexive engagement, the theoretical research presented here is able to think with the data that is set forth. As the work of design thinks-with the data, so does the work presented here.

Theoretically, these critical incidents give shape to the social and immaterial situations of use that are only possible to be glimpsed in the data itself. They serve as the eventful moments which force the product of design into existence as it is activated in use. Against the ever-present metaphysical charging forth of big data, it is these incidents which provide the making present of the general event of design. Represented in the user data, the critical incidents which guide the work of design make possible those conditions held within the large field of user data which mark off the beginning of the existence of the work of design. More than charting out the particular aspects and challenges faced in the design of MOOCs, these critical incidents chart out a more basic sense of how to understand the work of design in an era of big data.

As Althusser (2006) puts it in a fundamental discussion of the origins of the material idea of cause:

Epicurus tells us that, before the formation of the world, an infinity of atoms were falling parallel to each other in the void. They still are. This implies both that, before the formation of the world existed from all eternity, before any world ever was. It also implies that, before the formation of the world, there was no Meaning, neither Cause...
nor End nor Reason nor Unreason. The non-antiority of Meaning is one of Epicurus'
basic theses. . . . Then the clinamen supervenes. . . . The clinamen is an infinitesimal
swerve, as “small as possible”; “no one know where, or when, or how” it occurs or
what causes an atom to “swerve” from its vertical fall in the void, and, breaking the
parallelism in an almost negligible way at one point, induce an encounter with the
atom next to it, and, from encounter to encounter, a pile-up and the birth of a world—
that is to say, of the agglomeration of atoms induced, in a chain reaction, by the initial
swerve and encounter. (p. 168-169 )

Against the parallel falling of the data, the critical incidents appear as the swerve which
makes real the otherwise invisible substrate of the (im)material of design. It is this swerve of
the clinamen that is (metaphorically) charted out in the typology of critical incidents. In
understanding the work of design, this is a provisional charting, one which is dependent on
the particular and momentary forms that are given in the MOOCs as analyzed. They are not
eternal types, but nevertheless serve to illustrate the present movement of the events which
condition the process of design as it comes to radiate through the data.

The function of the specific work of design comes as it is thought-with the events that
are present in the field of data. So, while the work of design is possessed by certain
generative metaphors, traditions of values, and willful interpretations that guide its coming
forth in an event of decisive phronetic engagement, this engagement occurs in partnership
with a field of data charting the semi-arbitrary engagement of use. This sense of the semi-
arbitrary engagements of use comes as the volume of users and corresponding volume of data
is of such a size that they may contain multitudes. The values that are intended in the work of
design depend upon the emergent values that are generated through use and the historical
traditions which engender the interpretive valences of design and use. In their variety, these
conditions of design and use present an emergent and yet-unknown system of potential values.

Starting from a consideration of the relational values that are present in the work of interaction design as illustrated in the context of large scale data, design in general (as both specific design and the general sense of design that comes in use) comes to be about how to interpret the world differently. Users, designers, and all the valences of interaction that exist in between—each is commanded toward the continual re-interpretation of the status of object and the field which provides them context. This extends to the question of the researcher, the valences of the reflexive terms of interpretation that even this realization is bounded by.

Discussing Vattimo's (1997) hermeneutics, Santiago Zabala (2007) approached the question of interpretation as one which comes to link any interpretive response to its historical situation:

If, as Nietzsche lucidly recognized in his classic proposition, “there are no facts, but only interpretations, and this is an interpretation too,” then “interpretations” (and especially this second one) can be argued only as an interested response to a particular historical situation; they can be described not as objective findings based on external facts but as facts that enter into the same historical situation to which they correspond. (p. 21)

Beyond just opening up the metaphysical possibility for the work of design, what Santiago (voicing Vattimo) can be read to assert is that this kind of possibility for design is such that it occurs in wholly within the context of the historical conditions of use. The interpretation of design is a historical interpretation, whose result (the product of design) is itself only historically centered. In this, there is a following through of the aim to, as Suchman (2006) did with the condition of the user, situate the work of design (in a rigorous way) into the “same historical situation” to which belong the conditions of use. For considerations of
socio-technical design in which the immaterial social configurations are given equal footing to any physical instantiation, the interpretive work of design comes to be one of the reflexive development of history in total.

The work of design and the work of interpretation remain the same. What comes to be the case in facing the metaphysical rush of big data is the necessity of this interpretation. In this, Vattimo and Zabala's (2011) re-factoring of Marx's (1976) proposition (“the philosophers have only interpreted the world in various ways; the point is to change it”) as “the philosophers have only described the world in various ways; the moment now has arrived to interpret it” (p. 5) comes to have portentous effect. The active challenging forth of poietic revealing that comes in the interpretive movements of design (both general and specific) affirms this situation of the present moment. Today, there is a compulsion toward the continued interpretation of the setting of the world through the work of design.

In its challenging forward of the poietic interpretation of design, what big data gives to us epistemologically is, following Barad's consideration of the leveling of epistemology and ontology, also given ontologically. It expands not only the field of what is known, but the field of possibility. As has been detailed, these possibilities are linked, guided, and (in part) directed by this data. Big data which may have been in previous eras considered in purely epistemic terms comes to us as an onto-epistemic field of material/immaterial action in accordance with a Derridian conception of différance as that which “puts off until 'later' what is presently denied, the possible that is presently impossible” (Derrida, 1973, p. 278).

It is tempting to want to end this protracted discussion of the development of values, ethics, enframing metaphysics with a call toward the political interventions that may occur within such a field of interpretive actions (Vattimo & Zabala, 2011) as design. It could be possible to bound the metaphor in a politics of some kind of righteousness of design, political will, respect for values, openness toward a myriad of interpretive possibilities, or the
insistence toward change and betterment. Indeed, this can be seen in any number of instantiations of recommendations toward the social integration of design which hope to put forward values of inclusion and self determination (Bardram & Christensen, 2007; Borning & Muller, 2012; Ehn, 1988; Fischer et al., 2009; Irani et al., 2010). Such a final encouragement would seem to stop only half way, remembering only the intention of will, but forgetting the responsibility of the field itself. In many ways, this kind of moral injunction would mirror the compulsion toward progress that is goaded forward by the metaphysical challenging forward of big data.

Instead, in the end, what this analysis of the field of the engagement between design and large scale user data—in its diagnosis of the ethical event of design as a general technological practice, of peak empiricism, of the thinking-with of data and design, of the engagement of data as a tool, of the mapping out of the history of critical incidents in MOOCs, of the enframing rushing forward of data—lays out is a radicalized picture of the ways in which user-centered design is to be approached at a large scale. At an ontological level, looking at the field of the play of différance that gives force to Being, design and the interpretive use of user data presents a radically-open picture of the systematic happening of design in response to the needs of users. Under the conditions of large scale data, what comes to be most present in the mediated dialogic engagement between designers and users is the total field of this effect, one which is de-centered from any particular subjective perspective. Which is to say, that when considered in a fundamental fashion, above and beyond the intents of any particular act of design or use, things happen.
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