Alternative Ontologies of Number:
Rethinking the Quantitative in Computational Culture

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In an era of digital technologies, exponential rates of data production, and market-based technocratic governance, diverse practices of numeracy, quantitative inquiry, and software analytics become ever more ubiquitous. Yet, the dominant epistemological and ontological assumptions about number continue to rest on outdated philosophical frameworks. What is more, the data sciences continue to operate according to an ontology in which the natural world is assumed to be underwritten by mathematical laws (Manovich, 2013; Ruppert et al, 2013). Not only have these assumptions been deconstructed by posthumanist scholars, but recent work in philosophy begins to point toward alternative ontologies of number (Badiou, 2008; Châtelet, 2000; Deleuze, 1994; Meillessoux, 2008; Rotman, 2000) and new ways of theorizing measure and quantification (Barad, 2006; Kirby, 2011; Parisi, 2013). This special issue takes up these developments in the context of cultural studies, exploring computational reconfigurations of subjectivity and the social.

We focus on ontologies of number as a means of interrogating the kinds of computational practices that saturate everyday life. Contributors discuss how the ontology of number is at play in this historical moment, some papers exploring the implications for the social sciences and for social inquiry more generally, and other papers exploring how these developments alter the meaning of subjectivity and "becoming a statistic". This collection of articles is notable for how it offers both a critical evaluation of software culture as well as speculation on the diverse possible futures that might emerge from such culture. These articles take risks, tracking the historical lineages of various kinds of science and scientism, pushing past safe havens of critique to posit (tentatively) lines of flight and new ways of thinking computation. Many

of these projects inherit insights from philosopher Gilles Deleuze, who shows up in most if not all of these articles, tapping his counter-history of mathematics and his philosophy of immanence. There is much at stake in this theoretical move, as it relates to big data analytics, spurring one to ask, as Vicky Kirby (2011) does, how the earth might be investigating itself mathematically. Building on these articles, we see rich avenues for research, querying the potential of digital data analytics to be (re)deployed in new materialist analyses of power relations. Ultimately, this collection of papers fuels the hugely important discussions that are occuring across disciplines about how the very notion of life is transposed in this era of live data, and how software culture is remaking the human.

While the deconstructive workings of the discursive turn put into question the epistemological foundations of number, mathematics, and quantification, the interrogation of the ontological assumptions of number were not much troubled. Informed by thinkers such as Wittgenstein, Austen, Foucault, Derrida, and Lyotard, the discursive turn shed considerable light on how sociocultural and historical conditions shape the material conditions of human life. Discursive postmodern theories put Modernist ideals of objective knowledge and the accessibility of "truth" into question. Like many others, Lyotard (1980) argued that "Scientific knowledge is a kind of discourse" (p. 3). Although this important work helped focus attention on our epistemological limitations, insofar as objects of "nature" and scientific inquiry would always be mediated through signifiers, concerns emerged that the language-centric analysis of the world was excessively anthropocentric. And yet there are important figures from the discursive turn that are carried forth into what has been called the

ontological turn, particularly Jacques Derrida and Michel Foucault. Frequently cited in the articles of this special issue, Foucault's work on disciplinary power set the stage for the Deleuzian project of analyzing the control society.

In an age of ubiquitous digital technology, where biometric sensors are becoming the norm, and algorithms are making high stakes decisions, the ontological status of number itself must be considered. In this special issue we examine number as the engine of calculation and computation, but also invention and speculation. If the previous paradigm in social inquiry is that of the discursive turn, then the next few decades may be characterized by the turn towards computation, a turn that necessitates an entirely new way of thinking about numeracy. While the discursive turn emphasized how sociocultural and historical conditions shape and form our embodied experiences, the computational turn better attends to the agencies and materialities of algorithmic acts and software practices that are operating within digital architectures. These developments in digital technologies have become ubiquitous in our lives and produce massive amounts of data at exponential rates. Indeed, the footprints of social life are more and more digitalized while the acts of digital architectures are increasingly affecting/effecting the world. The computational turn in social inquiry will take seriously what software and digital cultural studies scholars have argued regarding software as the engine of society (Manovich, 2013) and algorithmic reasoning as a new form of thinking (Parisi, 2013). In other words, any theorizing of society will have to profoundly account for the ontological and epistemological dimensions of computation. Each of the articles of this special issue is working on the forefront of this effort.

In the first article, Patricia Clough's "Rethinking Race, Calculation, Quantification and Measure" illustrates a cultural studies of numeracy from a media studies perspective. Clough's focus is "new regimes of calculation" and both the limits and possibilities of mobilizing critical theory to make sense of such shifts. She uses Roderick Ferguson's Foucauldian call for a reordering of things in the academy to get at the rethinking of quantitative inquiry. She is especially interested in race and the twists and turns of how the institutionalizing of the interdisciplines of area studies in higher education functioned to manage difference. In almost a cautionary tale, she pays particular attention to parallels of the institutionalization of the interdisciplines of area studies with the emerging interdisciplines between the humanities, the arts and the social sciences and that of mathematical sciences, computer sciences, digital studies, and the natural sciences. By elaborating both sociological and media studies disciplinary perspectives, something "beyond biopolitics and neoliberalism" becomes thinkable.

In the second article, "Circuits of Amnesia: Cybernetic Memory and Real-Time Analytics", Orit Halpern maps the history of computational culture, tracking the underlying tenets regarding time and memory from early cybernetics to current focus on *smart* environments and "real time" analytics. Halpern argues that early computer science and cybernetics struggled with the relationship between memory and logic in a manner that continues to animate our machines and digital networks. She shows how the complex relationship between memory and logic is continuing to drive a dual imaginary of instantaneous analytics and collective intelligence, while fueling a relentless penetration of media technologies into life. A "new epistemology" is outlined where rationality is both embodied and affective and "'good science'' is an "account of chance and

indeterminacy." Affective logics are unpacked and "nervous networks" are theorized toward understanding the limits as well as possibilities of our "compulsion for analytics."

In "The Graphing of Difference: Numerical Mediation & the Case of Google's Knowledge Graph", Alexandre Monea explores Google search engines for how they operate through a particular logic of representation. He focuses on knowledge graphs and their mechanism for encoding facts and relations between facts. Graph databases operate on top of various pattern extracting algorithms, treating the Web as a gigantic databank of expository statements. Monea examines the ways in which these facts are encoded as "triples" of subject-predicate-object, and how this triple structure is directly linked to an Aristotelian logic of negation. He then taps Deleuze's ideas from *Difference and Repetition* to explore a notion of difference that escapes the mesh of representation, advocating for a poetics of data that might delve more deeply into a field of generative problems.

In the next article, "Calculating Matter and Recombinant Subjects: The Infinitesimal and the Fractal Fold" Elizabeth de Freitas argues that a historical approach to number and calculation reveals a rich field of diverse and often subversive mathematical practices, and that each of these practices might be taken up in social inquiry with radically different consequences. She focuses on the complex relationship between the continuous and the discrete in mathematical measurement, and explores the implications of a new materialist approach to number. Turning to Deleuze and Guattari's work on the infinitesimal and "the numbering number," de Freitas explores the possibility of subversive and inventive forms of calculation in which the continuous and the discrete are re-assembled in different ways. She shows how this approach subverts the idea of the

data point. Following Deleuze, she proposes the fold as the founding action in the universe. She shows how this intensive folding is exemplified in fractal topologies where we can glimpse how calculation can be *machinic but non-axiomatic*. This, she argues, is where the recombinant subject emerges, inflected by chance and algorithm.

Luciana Parisi's "Automated Thinking and the limits of Reason" explores how recent developments in computer and data science, such as machine learning, are creating a new kind of automated *reasoning* that transcends conventional images of machinic thought. Parisi uses Charles Peirce's tripartite model of reason (deduction-induction-abduction) and the insights of Gregory Chaitin and James Crutchfield regarding genetic algorithms, to show how automated computation has displaced the logic of deduction as the exemplary model of reason. She argues that Peirce's continuity across the tripartite model articulates a synthetic unity of discursive and non-discursive practices. Her proposal is that this allows for an ontology of information that is not simply represented in terms of syntactical connection between units, but would include a synthetic processing, that being a collective process of elaboration that better captures the kind of artificial intelligence to which we aspire. As an example of that kind of AI, Parisi opens the article with reference to the critically acclaimed movie *Her* in which an operating system develops beyond expectations.

Turning toward questions of the body and sociopolitical relations in digital architectures, Ezekiel Dixon-Román's "Algo-Ritmo: More-Than-Human Performative Acts and the Racializing Assemblages of Algorithmic Architectures" explores the question of what happens when more-than-human digital acts tell us something about ourselves. This contribution examines the ways in which the algorithms of data analytics

function in relation to other ontologies and assemblages and how they are shaping and forming our lives. In order to engage this question, Dixon-Román argues that data are assemblages that are materially and discursively produced from a multiplicity of apparatuses including sociopolitical relations of power and 'difference'. Leaning on Derrida, Parisi, and Barad, Dixon-Román examines the mysterious power of algorithmic prediction via what he calls *algo-ritmo*. Referring to the Derridean idea of iterability, algo-ritmo is, simply stated, the repetition of data with alterity, which enables the more-than-human performative acts of "soft(ware) thinking" of algorithms to function. He argues that algo-ritmo *becomes* what Weheliye has characterized as racialized assemblages that form and shape the more-than-human bodies within which they are in intra-action.

The article by Sam Sellar and Greg Thompson, "The Becoming-Statistic: Information Ontologies and Computerized Adaptive Testing in Education", examines current predictive analytic techniques in education assessment, mapping the shift from a disciplinary society to a control society in global education policy. The previous paradigm of assessment policy and practices relied on discrete and static standardized instruments that did the biopolitical work of a disciplinary society. The emerging paradigm is based on edu-business developments in deploying new computerized adaptive testing that uses continuous and rapid predictive analytics, performing the kind of modulation that characterizes the movements of control societies. Sellar and Thompson focus on Pearson's Next Generation Assessment program, and critically examine the assumptions of information science ontologies from a Deleuzian philosophy. They argue that Pearson's Next Generation Assessment as an information assemblage

that enables the production and communication of information via the interoperability of the axiomatic modeling of numerical data. Such adaptive testing technologies potentially limit the creative possibilities of learning.

In "Post-face: The Cultural Studies of Numeracy," Patti Lather provides a summary and conclusion to the special issue. Re-emphasizing its agenda as marking the shift from epistemological to ontological concerns in social science inquiry, she locates this special issue as challenging the orthodoxies of both positivist and critical approaches to the calculative, computational thinking and the limits of reason. With a focus on an escape from psychometrics in education research, she grounds her remarks in the context of the wider terrain of the possibilities of quantification for cultural studies and (post)critical inquiry.

The idea of this special issue emerged in July 2014 when the three guest editors joined a group of scholars at the University of Oregon for an American Educational Research Assocation (AERA) sponsored conference entitled "Beyond Reflexivity and Advocacy: Exploring the Ontological Turn in Social Inquiry." The organizers (Jerry Rosiek and Lisa Mazzei) organized small group discussions, assigning the three of us to lead a group entitled "Positivism and the New Empiricism." Previously unknown to one another and with each of us coming from different disciplinary perspectives and lines of inquiry, we converged around philosophical questions pertaining to the ontology and epistemology of number, mathematics, and quantification. That lively conversation led to this special issue where we combine our interests in the challenges that new forms of empiricism offer to standard ontologies of inquiry.

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