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SOCIAL ONTOLOGY IN BIG DATA ORGANIZING

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Summary

Computational ontologies (Pease 2011; Arp et al. 2015) are a key feature of data-sharing and data-labelling practices on the internet. Ontologies help integrate disparate or unorganized data to produce meaning, sort of "like a thesaurus, a finite set of terms, organized as a hierarchy that can be used to provide a value for an element" (Pomerantz 2015). Modern ontologies are an outgrowth of early artificial intelligence research in expert systems (Hayes-Roth et al. 1983) and knowledge representation (Sowa 1999). Today, many data-driven media technologies like virtual assistants and social media platforms use ontologies (Tecuci et al. 2016).

More specifically, media technologies like Google and Facebook's graphs, semantic web standards like the World Wide Web Consortium's Web Ontology Language (OWL), and virtual assistants like Siri, Cortana, Alexa, and Bixby provide unique opportunities for harnessing disparate data to increase knowledge mobilization via ontologies. However, like any technology, they can impede social progress if during their

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development designers are not also attentive to data justice issues. Ontologies present truly unique problems—they are not only a matter of quantification and sorting but also a matter of meaning. What counts as a restaurant in Siri's Active Ontology? How are social entities and relations defined in OWL? What languages do ontologies recognize?

Building and extending ontology work to data justice and social progress issues involves looking at how ontology is connected to data gathering, data modeling, databases, metadata, and how the use of these and other tools like application programming interfaces (Helmond 2015) impact civil society through public facing ontology-driven apps and technologies. Drawing on the work of Gitelman (2008), Srinivasan (2012) offers one such approach by asking how we might include computational ontology in our discussion of "ethical questions about the sovereignty of diverse knowledge, and whether the voices of emerging users should be ignored or empowered" (205).

What happens, for example, when digital objects represent social entities and relations (Kallinikos et al. 2010; Hui 2012; Krämer and Conrad 2017)? This is a modern update to an old problem, one we have seen in critical scholarship on the history of the census, statistics, and, more recently, big data (Hacking 1982, 1991; Beer 2016). The question "who counts?" can be read as a double articulation—who is doing the counting and who deserves to be counted? Data ontologies are an update to those problems, complicated by semantics ("who counts *what*?"). Currently employed in areas as diverse as municipal administration, virtual assistants, scientific knowledge sharing, production and logistics, and intelligence gathering, data ontologies that deal with social entities and relations necessitate what Couldry and Kallinikos describe as a "new ontology of the social" (2017: 153). Computational ontologies encourage the datafication of social entities and relations by constructing social ontologies (Searle 2006) to provide labels for data in organized, semantic structures. Once completed, one may combine and analyze heterogeneous data in ways previously impossible when they retained their own idiosyncratic labels, and computations can extract new information.

To set the stage, the first paper in this panel describes the upper level Ontology Industry. Drawing on in-depth, long form, unstructured ethnographic interview data collected from multiple senior stakeholders in a variety of ontology projects, including developers in the private sector and researchers at nonprofit organizations, the paper describes several global ontology initiatives, users, and potential to impact civil society.

The second paper discusses several formal ontology development activities being carried out within the broader polar community. The project "Mapping the Arctic Data Ecosystem" aims to develop a formal ontology and network model of the Arctic data system. Technical relationships are documented as are data sharing and financial relationships. The paper provides a critical analysis of observed problems, risks, and benefits of the formal ontology projects described.

The third paper provides an analysis of city ontologies and homelessness. It presents the results of primary research conducted as part of a critical data and software studies project carried out in Dublin, Boston and Ottawa. The study examined how digital data were materially and discursively supported and processed in three homeless intake and case management systems, PASS, HIFIS and HUD HMIS compliant systems and how these systems ‘made up’ homeless people.

The fourth and final paper provides a broader media theory of the ontological challenges that arise when ‘the social’, or at least particular important sites for sociality and the production of social knowledge (including ‘social media’) are computed: that is, constituted by and through the outcomes of deep forms of data processing driven by instrumental practices of control and/or profit making.

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THE ONTOLOGY INDUSTRY: PEOPLE, PRODUCTS, PRACTICE

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This paper provides an analysis of the upper level ontology industry, including its main designers, the diverse ontology products they produce, and the positionalities that inform their practice. The first bona fide computational ontology groups formed almost three decades ago and today there is a robust ontology community that includes several lower-level communities of practice. Here, I describe these groups and their activities, focusing specifically on a digital ethnography of the actual ontologies they produce that facilitate data sharing and interoperability for countless groups in both private and public spheres. Data for this paper was collected through long form, unstructured ethnographic interview data collected from multiple senior stakeholders in a variety of ontology projects, combined with a comparative computational analysis of ontology products.

Numerous ontology leaders (“ontologists” or “ontology engineers”) have emerged since the inception of the ontology industry by late-career artificial intelligence researchers in the 1990s. Many ontologists have at one point worked for Doug Lenat’s Cycorp. Lenat was arguably the first individual to take the challenge of representing knowledge through the construction of applied computational ontologies seriously. Through interviews with employees of Cycorp, I describe the firm’s genesis, its funding bodies through three periods of growth, the groups that splintered from Cycorp into Google after some early successes, and the main challenges and differences that make Cycorp distinct from other upper level ontology groups. Cycorp’s main product – the ontology Cyc, one of the longest running ontologies around – takes a unique approach to applied ontology compared to more modern ontologies on the market. Cyc’s ability to make “common sense” inference is based on decades of hand-curated logical axiom building, produced by employees (often philosophers) to describe complex facts about the world. Perhaps unsurprisingly, Cycorp leadership are quick to point out the unique benefits of Cyc’s reason engine, which was described to me as the only “true” upper ontology. Cyc is a propriety ontology that is used by teams in the public and private sector. Lastly, Cyc performs some level of ethical reasoning, an important fact about ontology.

Among the other ontology groups, Barry Smith’s involvement with the Basic Formal Ontology (BFO) has been instrumental in situating the BFO as the preeminent ontology in the fields of bioinformatics and intelligence communities. After interviewing ontology engineers involved in the development of the BFO, I was told about BFO's importance in the eventual success of enormous bioinformatics projects like the Open Biological and Biomedical Ontology (OBO) Foundry and BioPortal, two of the world's most comprehensive repositories of biomedical ontologies, as well as the USA's National Center for Biomedical Ontology. Smith – a classically trained philosopher – continues to build ontologies with the BFO, including highly expressive metadata ontologies to represent a countless array of informational artifacts. The BFO takes a different approach from Cyc and can be broken down not into millions of logical axioms about "common sense" facts about the world but rather a highly formalized, minimalist ontology where reality is essential divided into subcategories of time and space. There are several ethical questions that one can raise with administrators involved with BFO's application to intelligence databases, including issues of privacy and surveillance.

Natural language processing is a particularly difficult problem in ontology engineering, and to tackle this problem many ontologists prefer the Descriptive Ontology for Linguistic and Cognitive Engineering (DOLCE). Like the BFO and Cyc, DOLCE makes high level claims about the nature of the world. Where the BFO divides physical entities into neat containers without troubling with concepts and mental artifacts, DOLCE contains descriptors unique to those categories and follows a more "traditional" approach to ontology engineering that views ontology as the specification of conceptualizations (in contrast, the BFO engineers described their ontology as "realist" and not concept based). It is interesting to note the similarities between divisions in applied computational ontology with those of traditional philosophical ontology. Rounding out the public-facing ontologies is the Suggested Upper Merged Ontology (SUMO), the largest formal public ontology in existence today used for research and applications in search, linguistics, and reasoning. SUMO is connected to WordNet, a lexical database for the English language, and thus was described to me as being the most accurate upper level ontology with respect to its understanding of language.

Proprietary ontologies are also used by companies like Google, Apple, Amazon, and Facebook. Over the course of my interviews, I learned that ontology engineers from Cyc and other projects eventually made their way to developing products for those companies. Products like those developed by the Google affiliated Schema.org, Facebook and Google's graphs, and Apple's Siri all utilize ontological technologies to integrate heterogeneous data that are gathered from various orchestrated services like apps via application programming interfaces. Various engineers involved in these projects have been members of ontology communities like Ontolog, where I have also spent time interviewing leadership and analyzing their email exchanges. This paper will present each of these upper level ontology groups, provide a description of their various products and how they are applied to specific industries, and note the different practices that go into making up ontology work.

DATA SHARING IN THE POLAR DATA COMMUNITY: A CRITICAL APPROACH TO ONTOLOY, STANDARDIZATION, AND SEMANTIC FORMALIATION

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For many centuries, the term “ontology” referred to the branch of philosophy that deals with the nature of being: what constitutes reality, and possibly philosophical and cognitive questions related to how we conceptualize and categorize the world ("world view"). Over the last two decades, a new definition of ontology has been added to our lexicon. In the context of information science, “formal ontology” refers to an explicit (machine-readable) and formal representation of concepts and categories in a subject area or domain that shows their properties and the relations between them. Both philosophical and formal ontology are related, in that they both deal with how we conceptualize the world, however formal ontology is conducted in specific computer environments. The discussion in this paper will focus on the intersection of philosophical and formal ontology.

Many scientific disciplines, including the researchers and practitioners in the broader polar community (Agarwal 2005, Pulsifer and Brauen 2017), have adopted semantics and formal ontology as a significant area of research and development. Formal ontology applications use an ontology or set of ontologies to describe data, generate new knowledge through logical inference, and reconcile differences in meaning between knowledge domains. The formal ontology approach depends on standards used to expose, share, and connect pieces of data using transport protocols and unique identifiers. Ontology development is often driven by a set of ideal design criteria that establishes if an ontology is a “good” model of the world (Gruber 1993: 17). The characteristics of a good ontology include clarity, coherence, extendibility, and minimal ontological commitment, among others (Gruber 1993: 2-3).

Formal ontology proponents argue that, through linkage to scientific ontologies, formal representations of Inuit environmental terms and concepts can result in an enhanced cross-cultural understanding of the environment and improved resource management. However, little attention is paid to the broader implications of codifying, stabilizing, and analyzing Inuit knowledge using a logical framework driven by Western scientific ideals. The potential for destructive reduction of knowledge into a form that can be readily extracted from its production and cultural context is discussed.

Thus, rather than empowering scientific and local communities, the global exposure and broad dissemination of ontologies afforded by the Internet may result in a form of knowledge colonialism. Alternatively, if researchers and residents ignore this increasingly dominant form of knowledge representation, their voices may be silenced in key knowledge construction and information policy-making processes. At the same time, there are several collaborative, participatory formal ontology construction projects emerging in the polar community. These initiatives have the potential to minimize the risks while acting as a platform for building community.

This paper will discuss several formal ontology development activities being carried out within the broader polar community. The formal ontologies being developed include projects specific to a scientific domain. Originally, several independent projects aimed to formalize conceptualizations and relations in the domain of permafrost science. Through many organizing bodies, these activities became a collaborative, networked activity. Differences in the size and scope of projects reveal that power dynamics exist and must be considered in how this collaborative effort develops and is governed over time.

At a broader level, the project "Mapping the Arctic Data Ecosystem" aims to develop a formal ontology and network model of the Arctic (and eventually polar) data system. This includes human and technical actors. For example, key nodes within the model include "cyberinfrastructures" and "coordinating bodies". Technical relationships are documented as are data sharing and financial relationships. The project is evolving towards a social network model that can be used for understanding and planning community interaction.

The paper provides a critical analysis of observed problems, risks and benefits of the formal ontology projects described. While the benefits envisioned under the formal ontology are starting to emerge, the social construction of these knowledge artifacts is apparent, particularly in relation to power dynamics, cross-disciplinary and cross-cultural "disconnects", and the challenges of interacting across scales of information governance.

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OBFUSCATING COMPLEXITY WITH SMART CITY ONTOLOGIES: HOW THE STANDARDIZATION HIDES THE MESSINESS OF HOMELESSNESS

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The delivery of social services normally involves one or many face to face interactions. This is especially the case when it comes to accessing the myriad of services offered to people who experience homelessness. Most of these services are located in cities and access to these services is predicated on a face to face interaction where information is exchanged and recorded into an online shelter intake or case management system. Intake and case management systems intermediate and account for the exchange of services between a state service provider or a subsidized charity, not-for-profit or religious organization and an individual in need. A person who wishes to access must exchange personal information to access services which may be a shelter bed for the night, a meal, healthcare, identification, time with a social worker, a welfare check and a fee-based check cashing service, a shower, a laundry machine, a place to store a few possessions, a computer and a phone or just a cup of coffee on a cold day. If one is lucky, it might be information in exchange for a lease for more permanent housing. Often personal information is all a homeless person has, and people who experience are reluctant to share it, but share it they do in order to survive.

Just as there are many services for people who experience homelessness, there are many intake systems. In some countries, such as the Republic of Ireland, the Pathway Accommodation and Support System (PASS) is used by all state funded social services related to homelessness, whether they be a charity, a religious organization, a city service, health services or social housing. If organizations receive state funding for homeless services, they must use PASS. PASS is

“an online system that generates vital information in terms of managing access to accommodation. The system provides ‘real-time’ information in terms of homeless presentation and bed occupancy across the Dublin region. This therefore provides a more enhanced and up-to-date way of collating key information in terms of presentation to homeless services and service occupancy on a live basis” (Dublin Regional Homeless Executive 2018).

PASS data are shared between and among the organizations that use it and it adheres to Europe’s data protection laws. Ireland is however not the norm.

In Canada, social service delivery is the responsibility of the Provinces and each administers their services differently. Even though there is a nationally managed Homeless Individuals and Families Information System (HIFIS), it is not universally used by all shelters, nor are data shared within a city between shelters. The federal government manages the data and regional coordinators manage access to these data. There is a different intake system for social housing, another for health and so on. In the US, the Department of Housing and Urban Development (HUD) has a different strategy, it has developed a series of data collection, management, and reporting standards that local continuum of care providers must adhere to and must ensure that their local homeless management information systems (HMISs) are compliant with. HUD provides vendors who design, implement, and maintain an HMIS with resources such as “templates and tools, sample policies and procedures, training modules, and manuals” to help with compliance (HUD Exchange 2018).

This paper will present the results of primary research conducted as part of a critical data and software studies project carried out in Dublin, Boston and Ottawa as part of the European Research Council (ERC) funded Programmable City project based at Maynooth University in Ireland. The study examined how digital data were materially and discursively supported and processed in three homeless intake and case management systems, PASS, HIFIS and HUD HMIS compliant systems and how these systems ‘made up’ homeless people. The primary study site was Dublin where the author conducted a series of semi-structured interviews with state actors charged with developing system requirements, as well as developers, operations managers, and multiple service providers, the national statistics organization and Dublin City Council policy makers and researchers. The analysis of transcribed data is complemented with a close reading of grey literature such as training manuals, specification documents, reports and data. A shorter but similar process was followed in both Boston and in the City of Ottawa. Ian Hacking's dynamic nominalism framework theoretically framed the study of data, classification systems and indicators while a socio-technological assemblage framework informed the broader analysis of the context within which these three intake systems are situated, how the technologies were developed and how data collection was standardized and routinized.

The results of this project empirically conclude that counting and accounting for the experience of homelessness is the result of a complex assemblage of legislation, regulation, and policies combined with funding rules and the historical evolution of local social service delivery models. This assemblage of elements manifests in intake systems as templates, drop down menus, tick boxes and pages architected in such a way as to standardize the data collected during the face to face encounters with people living very real and messy experience. These are often a city's most vulnerable people. These intake systems and their data do not necessarily manage the housing and social support needs of the people on the other side of the desk experiencing homelessness but more so inform the very clean, organized technocratic service delivery system that audits and funds services for the homeless. Furthermore, homeless people according to PASS, HIFIS and HUD systems are not the same and it is not possible to compare the data about homelessness between jurisdictions precisely because the assemblage of elements that influence how data are collected 'make up' homeless people differently.

The drive to develop 'common yard sticks' remains nonetheless strong. The ISO 37120:2014 Sustainable development of communities — Indicators for city services and quality of life standard is one such initiative supported by smart city enthusiasts. In Canada at a recent National Homelessness Data Summit, a group of software engineers tried to convince a room of front line service providers and social workers that the best way to understand homelessness was to develop a top down homelessness data ontology as part of a newly designed software intake system. The assumption was that current practices are messy because social workers do not understand ontologies nor computers. It is hard to follow a data trail and see in real terms how they change a mind, a policy, or loosen purse strings. However, it is easy to see the effects of R&D funding that stipulate the requirements to partner with cash strapped social services. Those who work on the front lines have seen this before, and are becoming data literate and technologically savvy, and know not to accept all the free technology that comes their way. It is not to say that engineers, ontologies and a new intake system will not help with the delivery of social services, but it is wrong to assume, as the results of this research demonstrates, that data ontologies can clean up a messy data space, especially if proponents walk in without subject matter expertise and an attitude that past does not matter.

COMPUTING ONTOLOGY AND SOCIAL ONTOLOGY: WHEN APPEARANCE IS CALCULATION

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This talk will discuss the ontological challenges that arise when – as increasingly universal today – 'the social', or at least particularly important sites for sociality and the production of social knowledge (including 'social media'), is computed: that is, constituted by and through the outcomes of deep forms of data processing driven by instrumental practices of control and/or profit making.

This process is not the result of corporate conspiracy. Its starting-point is the fact, noted by Philip Agre (1994) more than two decades ago, that computing, in the social form of computing that is today taken for granted, operates by tracking every significant change of state that occurs on each computer. Since, following the commercial expansion of the internet from the mid-1990s, every computer is in principle accessible to every other via the internet, the combination of tracking and connection means that every computer is in principle trackable by every other. Since significant computing capacity is increasingly embedded into every point in space and time (at least, every point from which action occurs), an entirely new type of social order has developed, based on ordering through computer tracking. It is interesting to approach the implications of this from the perspective of social ontology (Couldry and Kallinikos 2017).

If ontology in philosophical terms is an 'investigation concerned with being' and (according to leading realist philosopher Markus Gabriel: 2015: 1, 166) 'existence is *appearing* in a field of sense', social ontology is concerned with how things appear in the social field of sense. Both the embedding of computing at every point of social action (through e.g. mobile phones) and the development of platforms for focussing social action have changed profoundly the social 'space of appearances' (to borrow Hannah Arendt's well-known phrase), that is, social ontology. But this is not a simple transformation: the computing processes on which the new social appearances are based are profoundly tied to processes of categorization (Bowker and Starr 1999) which underlie the data that computers can track, and platforms gather. This has major implications for the type of social world we can inhabit, and the sorts of order and reality it can exhibit (Boltanski 2011: 57).

The *first* implication is that social interaction of multiple sorts, when online or conducted in interaction with devices that are connected online, is increasingly organized to generate a computable and ultimately tradable data footprint. Discrete data are aggregated into larger units that, through their ceaseless processing, generate value. The goal of generating economic value in turn is reflected in the design of interfaces where social actors operate. In this way the values of platforms and other data-generating interfaces are involved in the shaping of the social forms through which interaction takes place. Social appearance (social *ontology*) becomes closely linked to *axiology*, what is valued. In this respect, the consequences of computing's recent embedding in social life can be compared with the change in the axioms (or implicit values) of everyday life that Ivan Illich (1996) noted in his history of a decisive phase in the use of written texts in the early Middle Ages.

But – and this is the *second* implication – this value-driven shift in social ontology is more than a general fact. It is part of a wider construction of social order, an order shaped for and by capitalism, that embeds a new *rationality* closely linked to the ideology of datafication (van Dijck 2014). How should we understand the rationality that guides this new social order and its social otology? This rationality can be understood as the apotheosis of what to date has been called 'Western' rationality, focussed on the elimination of difference and the construction of a complete social and economic order geared to absolute control. There is therefore a remarkable continuity between the current developments in data and capitalism, read critically (e.g. Zuboff 2015), and the critique of Western *colonial* rationality for suppressing difference and heterogeneity, developed by Peruvian postcolonial theorist Aníbal Quijano in the 1990s (2007/1992). Potentially, this provides the basis for a wider critique of contemporary data practices as *colonial*. But there is one crucial difference from historical colonialism: that the new data-driven rationality which is at the heart of most business models today is being pushed forward not only from the West, but also from market-states such as China. In authoritarian states such as China, social ontology is much more than a theoretical or philosophical question: under conditions where the state is closely allied to the economic forces that manage the digital platforms for social life, the link between social appearances, social ontology, and social order is much more explicit than in the 'West'.

Social theory/ontology in this way (and, connectedly, computing theory/ontology, which underlies the transformations now under way) has a political significance. Changes in what can be computed and what must be tracked in computer-based fields of social appearance entail a new form of social order, co-extensive with capitalism, and with major implications, potentially, for what can count as political order, too.

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