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Rethinking big data in digital humanitarianism: practices, epistemologies, and social relations

Ryan Burns

Abstract Spatial technologies and the organizations around them, such as the Standby Task Force and Ushahidi, are increasingly changing the ways crises and emergencies are addressed. Within digital humanitarianism, Big Data has featured strongly in recent efforts to improve digital humanitarian work. This shift toward social media and other Big Data sources has entailed unexamined assumptions about technological progress, social change, and the kinds of knowledge captured by data. These assumptions stand in tension with critical geographic scholarship, and in particular critical GIS research. In this paper I borrow from critical research on technologies to engage three important new facets of Big Data emerging from an interrogation of digital humanitarianism. I argue first that within digital humanitarianism, Big Data should be understood as a new set of practices, in addition to its usual conception as data and analytics technologies. Second, I argue that Big Data constitutes a distinct epistemology that obscures many forms of knowledge in crises and emergencies and produces a limited understanding of how a crisis is unfolding. Third, I argue that Big Data is constitutive of a social relation in which both the formal humanitarian sector and "victims" of crises are in need of the services and labor that can be provided by digital humanitarians.

Introduction

With the advent of Big Data, crowdsourcing, and the geoweb, *digital humanitarianism* has taken off in humanitarian practice, with some promising that traditional humanitarianism has now been "revolutionized" (Meier 2012a). Digital humanitarianism can be conceptualized as "the enacting of social and institutional networks, technologies, and practices that enable large, unrestricted numbers of remote and on-the-ground individuals to collaborate on humanitarian management through digital technologies" (Burns 2014). It consists of organizations like the Standby Task Force, the Humanitarian OpenStreetMap Team, and the Digital Humanitarian Network, digital communities which produce and process humanitarian data in platforms such as Ushahidi, OpenStreetMap, Tomnod, and Sahana. These groups often synthesize information from multiple sources—social media, Short Message System (SMS; colloquially, "text messages"), aerial photography, and more traditional spatial databases.

Such digital humanitarian innovations have enabled incorporating massive, unstructured datasets —what some have called "Big Data" (Howe 2006; Lohr 2013; Mayer-Schönberger and Cukier 2013)—into humanitarian interventions, and this incorporation has been

R. Burns (✉)
Department of Geography, University of Washington, Box 353550, Smith Hall 408, Seattle, WA 98195, USA
e-mail: burnsr77@gmail.com

welcomed as forward progress for the field. Indeed, over the last year seminal reports have been published by the formal humanitarian sector that laud the promise of Big Data within digital humanitarianism (Letouzé 2012; UN OCHA 2013). In these conversations, Big Data is heralded under discourses of increased speed and efficiency, inclusivity, and actionable information. Humanitarianism as we know it, according to these accounts, is likely to be permanently dislodged from its *modus operandi* through modernization (Olafsson 2012).

These optimistic narratives stand in tension with critical geographic scholarship, both around information technologies and around humanitarianism. Borrowing principles from critical GIS, technologies can be seen to embody social norms and values (Schuurman 2000; Sheppard 2005), often reinforcing extant power dynamics and social inequalities rather than disrupting them. Humanitarianism likewise has been critiqued as a social relation that often privileges, both discursively and materially, the global North (Hyndman 2009; Polman 2010; Weizman 2012). Moreover, Big Data has recently been the focus of critical inquiry, with some seeking to discern the limits of what can be known through this medium (Barnes 2013; Boyd and Crawford 2012; Crawford 2013; Haklay 2013; Thatcher 2014). If information technology and humanitarianism are both complex, uneven social and spatial practices, what are the implications of their convergence with Big Data?

Informed by a recent ethnographic research project, in this paper I call into question the ways Big Data has been positioned in relation to humanitarianism.[1] Big Data in digital humanitarianism exemplifies significant theoretical limitations that bear recognition in light of Big Data's promises. These limitations can be understood in relation to key principles from critical information technologies research, including critical and feminist GIS. In this paper I review and analyze existing research practices and from that, develop a conceptual framework to better understand the present and

(potential) future of digital humanitarianism from a broadly human geographical standpoint, beyond the more instrumental and narrow focus being touted in the media. The rest of this paper is structured as follows: first I introduce the field of digital humanitarianism, describing both its constituent technologies and its new social, political, and spatial practices. I explain the ways Big Data has been situated in relation to digital humanitarianism, drawing attention to its purported benefits, particularly in two key texts. Next I draw out Big Data digital humanitarianism across three analytical lines in order to critique the ways it has been conceptualized in research to date. The three lines of analysis include, first, a new set of practices around providing humanitarian aid, second, an epistemological approach toward *needs*, and third, a discursive and material social relation. This discussion is informed by a recent ethnographic research project which originated at a research institution focused on digital humanitarian issues. I conclude by suggesting ways in which the process of integrating Big Data with digital humanitarianism may benefit from critical geographic theory contributions.

Critical perspectives on spatial technologies

In this section I review current research around spatial technologies in order to leverage those principles in a critique of Big Data. I draw upon critical, participatory, and feminist GIS for two reasons. First, within geography it remains the primary source for critical perspectives on technology. Others studying diverse dimensions of the geoweb have shown that lessons and principles from these fields provide substantial grounding for more recent socio-technical practices such as Big Data (Elwood 2010). Second, *data* is central to this literature. As I show below, these fields have provided robust perspectives on the social and political nature of data production and consumption. This literature has been informed by science and technology studies research, so I likewise draw upon this literature insofar as it theorizes data in ways conducive to understanding its geographic implications.

Critical, participatory, and feminist geographic information science (GIS) research has shown that technologies and data come to embody epistemologies and social relations through several mechanisms. The context in which technologies are developed—*where* they are developed (Rundstrom 1995; Zook 2005), *who* develops them (Kwan 2002; McLafferty 2005),

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[1] Within this emerging field there is significant overlap of many related concepts, including *digital humanitarianism*, *Big Data*, *social media*, and *crowdsourcing*, and the broader concepts of *humanitarianism* and *development*. In this paper I seek to be clear where debates explicitly revolve around one of these ideas, although the overlap between them allows for some analytical strength in ambiguity and generalization. While each of the concepts entails different processes, people interviewed for this research project tended to use them interchangeably, which reflects the persistently slippery nature of the concepts to date.

the structural and institutional needs they are designed to satisfy (Aitken and Michel 1995; Leszczynski 2012; Pickles 1995, 2004)—contributes to the affordances and implications of those technologies. Research showing the uneven spatial distribution of technologies across the globe suggests an uneven representativeness of participation in the determination of how those technologies will be developed (Fernandez-Maldonado 2004; Graham 2008; Graham et al. 2011). Importantly, this conceptualization of the *digital divide* exceeds the common definition of access to technology to include the ability to use and influence the development of technologies (Gilbert 2010). These understandings of spatial technologies build on lessons from science and technology studies (STS) research that describes the processes by which data and technologies come to assume and reify social and power relations, worldviews, and epistemologies (Feenberg 1999; Pinch and Bijker 1987; Wajcman 1991; Winner 1985).

These dimensions of technology affect its attendant social and political relations. Importantly for this paper, technologies impact the relations between the individuals or groups with the ability to possess, use, and influence the development of those technologies, and those who do not have this ability. An extant prominent disparity is between the global North and the global South, with many widely-popular technologies developed in, and intended to be used by, the global North (Hands 2011; Howard 2007). These contexts influence the ways in which technologies can be used, as well as the social and political relations they build or reiterate.[2]

Similarly, data artifacts and the ways in which they are represented both reflect and impact social relations. This dynamic occurs as early as in the decisions around the kinds of knowledges and information to be incorporated into data structures, and influence the legitimacy and power those data-knowledges are recognized to have (Corbett and Rambaldi 2009; Elwood 2010; McCann 2008; Wilson 2011). Representing this data signifies particular epistemologies and enrolling a form of legitimacy and power often

given to visual map-based artifacts (Elwood 2006, 2009; Kwan 2007). These *knowledge politics* are thus embedded in multiple points of technology and data—in the framing of what "counts" as data, how those data may be represented, and the purposes to which such representations may be put (Elwood 2010; Elwood and Leszczynski 2013).

Research looking at the social and political implications of digital humanitarianism has begun fruitfully borrowing these principles to explore the values, norms, and implications of this convergence (Burns 2014; Crawford and Finn this issue). However, to date this has not interrogated the relationship of Big Data to digital humanitarianism. Such work could potentially inquire into the affordances, closures, and impacts imparted by the social nature of Big Data onto digital humanitarianism. Thus, what is needed is work toward a preliminary understanding of the social and political implications of Big Data in digital humanitarianism viz-à-viz its promises in current discourses.

Big Data within digital humanitarianism

Big Data can be understood as an emerging subset and influential trend within the historical development of digital humanitarianism. By most accounts digital humanitarianism emerged as a specialized field through the outcome of the 2010 earthquake near Port-au-Prince, Haiti (Hesse 2010; Munro 2013; Zook et al. 2010).[3] During this humanitarian response Mission 4636[4] established a dedicated SMS number through which people could report requests for help or resources; the Ushahidi platform helped coordinate the processing, georeferencing, and mapping of this datastream (Liu et al. 2010; Meier 2010; Meier and Munro 2010). Much attention has been given also to the massive amount of spatial data produced in OpenStreetMap the days following the earthquake (Chapman 2010; Maron 2010). Each of these technologies—and other technologies later categorized under digital humanitarianism (such as Sahana)—existed prior to this humanitarian response. However, the Haiti response is often considered the watershed moment for the field (Crutcher and Zook 2009; Gao

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[2] To be sure, much research has shown that technologies are not determinant in their social and political implications; there is a social shaping of technology that can take their use in ways neither intended nor anticipated by those who developed them (Elwood 2006; Fischer 1994).

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[3] MapAction, founded in 2003, is often credited as one of the first digital volunteer groups (Crowley and Chan 2011).

[4] See: http://www.mission4636.org/.

et al. 2010; Meier and Munro 2010), with Jacobo Quintanilla of Internews saying, referring to the response, "Haiti has been a revolution. The technology community has engaged for the first time in a very important and permanent manner in a humanitarian operation" (Crowley and Chan 2011, 34).

To traditional humanitarianism, digital humanitarianism can add diverse techniques such as crowdsourcing, social media operations, remote volunteer collaboration, data production and processing by people unaffiliated with a formal humanitarian institution, and "crisis mapping" (Burns 2014). However, there is no formal relationship between the traditional humanitarian institutions and digital humanitarian organizations. Becoming involved in a humanitarian response entails a traditional humanitarian agency "activating" a digital humanitarian organization, many of which are affiliated with coordinating organizations such as the Digital Humanitarian Network and NetHope. Activations are limited periods of time when the formal humanitarian agency tasks a digital humanitarian group with specific tasks; activations normally last between 24 h and a month.

Within digital humanitarianism conversations around Big Data have only recently commenced, with most conceptualizing Big Data merely as a new source of data. Letouzé (2012, 9) claims the Big Data "revolution" is "extremely recent (less than one decade old), extremely rapid (the growth is exponential), and immensely consequential for society, *perhaps especially for developing countries*" [emphasis mine]. Letouzé thus distinguishes a Big Data moment by positing a clean historic break: at a relatively discrete point Big Data emerged as an exponentially-growing flow and store of data that affects society in fundamental ways.[5] De-historicizing in this way is a common approach to Big Data (Barnes 2013; Barnes and Wilson 2014). At stake alongside

this new data source is, as UN OCHA (2013, 3) puts it, "a better model for making humanitarian policy, whereby people determine their own priorities and then communicate them to those who would assist." Despite the promise of digital humanitarianism being large numbers of people contributing large amounts of data, this quote suggests that individual people are communicating directly with those in control of resource allocations. Similarly, Ziemke (2012, 108) argues that the goal of digital humanitarianism is not to connect the many needy individuals with aid providers but instead provide institutions with "just the right piece of information that might save a life." Notwithstanding these irreconcilable discrepancies, incorporating Big Data into workflows is said to help develop "data-driven decision-making processes"—which are contrasted with "experience and intuition" (Letouzé 2012, 12). This sentiment reflects the view put forward in the highly criticized article on Big Data by editor of Wired, Chris Anderson (2007):

> This is a world where massive amounts of data and applied mathematics replace every other tool that might be brought to bear. Out with every theory of human behavior, from linguistics to sociology. Forget taxonomy, ontology, and psychology. Who knows why people do what they do? The point is they do it, and we can track and measure it with unprecedented fidelity. With enough data, the numbers speak for themselves.

However, discussions of the relationship between Big Data and digital humanitarianism tend to be cautiously optimistic. Letouzé (2012) the challenges facing digital humanitarianism as falling into five broad categories: (1) privacy, (2) access/sharing, (3) extracting meaning from qualitative text, (4) apophenia, (5) detecting anomalies. Similar characterizations of challenges can be seen elsewhere (HPCR 2012), usually framing challenges in ways that make them addressable through technological means. This conceptualization sees "challenges" in terms of hindrances to the integration of Big Data and humanitarianism, and "progress" as moving toward increasing integration of Big Data into humanitarianism.

These early conversations suggest a Big Data future is, for those managing the development of digital humanitarianism, seen as imminent, value-neutral, and mostly centered on new data sources, with

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[5] Although Letouzé was writing about development rather than humanitarianism, I include it in this discussion because, while the two fields differ on their operations and intellectual histories, they share many of the same underlying assumptions. They share assumptions about *who* has resources and should deliver those to *whom*, they are traditionally based on economistic principles of resource distribution, and it can be said that their humanitarian/development situations often result from inequalities in global political economy. In Polman's (2010) critique of humanitarianism, for example, she often looks at organizations straddling both sides of the humanitarian-development fence.

obstacles delegated to technicist solutions.[6] This conceptualization stands at odds with the research showing how technologies, data, and society are co-constitutive, such as in critical, feminist, and participatory GIS. Not only does the convergence of Big Data and humanitarianism depend on a particular social shaping of technologies and data, but Big Data itself embodies particular values, social relations, and epistemologies.

Methods

The following sections have been developed with evidence from a recent one-year *extended case method* (see: Burawoy 1998) research project that commenced from work with a research institution. My work with this institution introduced me to many of the key actors and developments of digital humanitarianism, and thus I engaged this particular case as an especially fruitful site for exploring how digital humanitarianism has developed and is impacting broader-scale relations. The institution itself pioneers research at the intersection of technology and society, with specific focuses on Big Data, humanitarianism, disaster management, crowdsourcing, and social media.

During my work with this institution I hosted and attended numerous important workshops, conferences, conference calls, and roundtable discussions. These events were attended by many federal and international disaster and humanitarian managers and many from the digital humanitarian community. I was told by interviewees that some of these events were seminal moments in the development of digital humanitarianism, as they raised and addressed hindrances faced by the formal humanitarian sector and informed the prominent actors on the state-of-the-art technology offerings.

In the research project I used work with this institution as a case through which to explore the broader phenomenon of digital humanitarianism, combining evidence from participant observation, data archiving, 37 in-depth semi-structured interviews, and formal online training modules. The data collected for this extended case method was collected entirely

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[6] As Kitchin (2013) has noted, however, conceptualizations of Big Data are inconsistent, adopting different tenets depending on the context.

independent of the institution, using that work merely to commence the extended case method. This collected data was transcribed, coded, and analyzed with the goal of identifying the primary themes, patterns, and ways of thinking about the relation between Big Data and digital humanitarianism. In what follows, my analytical framework combines the extended case method with discourse analysis. Discourse analysis is useful for identifying and theorizing systems of meaning that are produced and articulated in particular contexts (Dittmer 2010; Doel 2010). All names and identifying information have been replaced with pseudonyms and general non-identifying information.

Big Data as digital humanitarian practice

The growth of Big Data within digital humanitarianism should be seen not simply as a new source of data, but instead as a shifted set of practices, as an epistemology, and as an emergent social relation. These have emerged at the nexus of new technologies, data, and social and institutional collaboration techniques. The contexts for this conceptualization are unfolded over the following three sections, respectively.

Big Data signifies new digital humanitarian practices in at least two contexts: within the emergent digital humanitarian community and within the formal humanitarian response community. The first is constituted by the large numbers of people involved in developing, supporting, and participating in digital humanitarian practices around producing, processing, visualizing, and analyzing Big Data. While there is no institutionalized relationship between digital humanitarians and traditional humanitarian institutions, the former conceptualize their role as anticipating and pre-emptively fulfilling the conceived needs of the latter. In response to my inquiry into the relationship between Big Data digital humanitarianism and the traditional humanitarian actors, one prominent digital humanitarian leader replied,

> I work on… the field of advanced computing to identify solutions to major challenges that exist in the development, humanitarian, and journalism space. … My whole role is to bridge the advanced computing community with the humanitarian, development, and journalism community.-(Robert, personal interview, 2013)

For this person, this process of identifying solutions usually entails developing the frameworks for new practices before the community consciously needs this shift in practices:

> The main impact we have had for the past 6 months is raising awareness that something called 'advanced computing' *does* exist, that machine learning and artificial intelligence, social media analytics, are all areas of applied research that are at the cutting edge and have direct applicability to the humanitarian, development, and journalism space. Most of the talks I give now, when I interact with humanitarians, and I tell them that, 'Here's what's possible,' their eyes light up; for them it's science fiction because advanced computing is not our field… [The traditional humanitarian community] is not in any way prepared to manage the rise in Big Data and we're not able to make use of it or leverage it to its full potential. So that is where the really difficult questions are right now.- (Robert, personal interview, 2013)

Thus, the digital humanitarian community is not simply encouraging increased use of new data sources. Instead, they bring new practices into being in relation to Big Data. Within digital humanitarianism Big Data constitutes a new practices around collecting, processing, visualizing, and collectively making sense of that new data. Big Data, through these new practices, reconfigures how digital humanitarians conceptualize their own contributions to humanitarianism. As one interviewee described their organization's purpose, "The goal isn't to produce data; the goal is to *filter* data. The data is already produced; it's already out there, so we find it and filter it" (Jasmine, personal interview, 2013). Most digital humanitarians view this contribution as "just another tool in the toolbox." For Jasmine, the leader of a major digital humanitarian organization, "You don't base your decisions *only* on what [our organization] is telling you—you use the piece of information we give you and see if it plugs into the rest of what you know, and is that helpful?" This sentiment was echoed often at the 2013 International Conference of Crisis Mappers, where, for instance, attendees representing Ushahidi stressed repeatedly that their software is a small component of a large and complex process, *not* a standalone solution.

Those in the formal humanitarian response sector, in contrast, communicated to me their apprehension that Big Data represents too significant a departure from established and tested humanitarian and emergency management practices to take root. Formed differently, these people are concerned that parties pushing Big Data digital humanitarianism do not adequately understand the operational protocols and institutional needs of humanitarian and emergency management organizations, or they offer technologies that do not meld into pre-existing practices. In a personal interview Peter, a spatial data manager for a major international non-governmental organization and prominent member of a digital humanitarian organization, communicated a widely-applicable skepticism: "A lot of the excitement these days is around crowdsourcing—users submitting their own data to organizations—and I think there's a lack of understanding that a lot of organizations like us are not able to use *our own data* particularly well. … There's all sorts of interesting dialogue going on at that level, but it ignores the fact that oftentimes we don't have our own [information management] stuff together." Kevin, a municipal emergency manager who has been active on social networks as a way of pushing emergency information to the public, expressed caution with regard to integrating "crisis maps":

> Well, I'm skeptical. I'm always skeptical on any subject. Until I personally experience a direct "a-ha!"—where you can't miss it—and I've seen lots of write-ups…. In the disaster world I've seen plenty of examples, heard lots of examples at [a recent digital humanitarian workshop]. But I'm always, in the back of my head, saying, 'But who's this for? Who's consuming it? You're doing it, it looks great, people are reporting from all over the world, but who's consuming it?' So that's maybe number one. Now wouldn't it be better if you were building something that was a direct solution to a challenge that a government that's responsible for resolving the situation? If nothing else, having those things connected to people that can actually do something about it.-(Kevin, personal interview, 2013)

Far from merely adding "another tool to the toolbox", this suggests Big Data should be seen as a potentially substantial transformation of practices around data

procuring, analyzing, and sharing. Accordingly, its future utility in humanitarianism is neither inevitable nor, as will be discussed in the next section, value-free.

As discussed above, the discourses digital humanitarians use to describe their field's operations suggest an enormous presence of volunteers emerges in response to each disaster. In contrast with these general discourses, individuals are more likely to acknowledge enormous efforts required to attract and sustain those inflows of volunteers, and to maintain the social and psychological well-being of ongoing volunteers. Digital humanitarians working with Big Data have developed new practices to attract and sustain inflows of volunteers: "when you're involved in distributed computing you must offer an incentive to maintain interest and participation" (Kathleen, personal interview, 2013). Such incentives thus far have included motivational emails (Jarmolowski 2012; Standby Task Force 2013), emails of thanks sent from the activating agencies (Jasmine, personal interview, 2013; Leitch (@DanielleLeitch) 2012; Standby Task Force, public email, 2013), moving contributors from one specialized task group to another in order to sustain interest and possibly metal well-being (Kathleen, personal interview, 2013), and gamification of tasking platforms.[7]

Big Data as digital humanitarian epistemology

The incorporation of Big Data into digital humanitarian involves producing notions about *what can be known* through information produced on social networking sites, SMS, and distributed digital collaboration. In the cases where Big Data is engaged in a digital humanitarian project, digital humanitarian liaisons must frame Big Data products as useful to formal humanitarian institutions. How they frame this knowledge production influences the form and degree of legitimacy they are given. In order to frame this usefulness, they must make conjectures about what can be known through Big Data information and their organizations' crowdsourcing practices. While such

epistemological framings, as discussed above, are common in discussions around technology generally (Elwood and Leszczynski 2013; Fuchs and Sevignani 2013; Wilson 2011) and Big Data specifically (Barnes and Wilson 2014; Boyd and Crawford 2012; Kitchin 2014; Thatcher 2014), particular uncertainty surrounds Big Data in digital humanitarianism because of the contrastive geographies between a locally-situated person in need and the distantly-located digital humanitarian.

Most digital humanitarians frame the utility of their data and data practices in one of three ways. The first, most common framing, is around improved situational awareness, knowing what is happening in the location of crisis or emergency (Jasmine, personal interview, 2013; Robert, personal interview, 2013). Rachel, the founder of a preeminent digital humanitarian organization, put this framing most forcefully:

> [T]he greatest benefit of any of the technologies … is situational awareness. … I really think that the one thing that technology can provide is organized, structured data that helps with the disaster response and recovery. And I don't think there's anything else it can do.-(Rachel, personal interview, 2013)

According to the broadest form of this framing, there may or may not be direct, actionable operations information involved. Jeroen (personal interview, 2013), a software developer for a popular digital humanitarian platform, said formal humanitarian institutions derive value not from "individual pieces of information, but in general patterns." The second way Big Data is framed as an improvement is through the potential to receive unmediated reports of people's experiences (CrisisMappersNet 2012). Robert expressed this by noting (personal interview, 2013), "…the vast majority of crisis information today is generated by these local communities rather than UN staff or what have you. UN staff can't be everywhere—the crowds are—and so they're the eyes, ears, and sensors, and they're becoming empowered to communicate during crises." The third framing, which was communicated only rarely, is in the potential of a project to enroll enough distributed laborers to have work conducted constantly. For example:

> If we can get 200 people working on a deployment, that's 200 people that are working across

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[7] See: http://www.tomnod.com. Tomnod is a site that tracks a user's contributions through a sort of individual profile. In the case of the recent "Wildfires in Australia" project, contributors sorted satellite imagery and were rewarded with increased "Cred".

timezones, which is really important as well. So, say we're working with [UN] OCHA in Geneva, we still have people working on the west coast of the US, so when Geneva is asleep and everybody else is still working away, by the time they wake up they see that a massive amount of work has been done overnight. And it gives them the sort of 24/7 workforce…-(Jasmine, personal interview, 2013)

The limits of these Big Data approaches lie in the ways the technologies, data structures, and software limit what knowledges can be collected, how those knowledges are processed, who is able to contribute, and who is able to access them. These epistemological limits are observed mostly by those working in formal humanitarian institutions, and contrast with how the digital humanitarian community envisions their own contributions. At the same time, by framing their technologies in the three ways seen above, the digital humanitarian community produces a conception of what can be known through Big Data, a conception that aligns with the common promises of Big Data but contradicts the ways those knowledges are engaged by formal humanitarian actors. These framings accomplish this by embodying three potential contributions, and then suggesting that knowledges produced through Big Data means should contribute in one of those three ways. Conversely, knowledges that do not immediately conform to one of these three framings should be deemed superfluous. This conception also narrows the complexity surrounding knowledge production and representation, eluding the broad epistemological potentials found in critical and feminist GIS research.

With regard to Big Data, the primary questions humanitarian responders raised revolved around its completeness. This questioning differed from geoweb debates in which statistical representativeness is a measure of the relation between a sample population and the general population; instead, it asked *who* is contributing and who is unable due to the nature of humanitarian emergencies. For example, at a recent digital humanitarian conference a spokesperson for Frontline SMS succinctly encapsulated the sentiments expressed to me by most formal humanitarian managers, "If the only people who can post to your platform already have internet, you're missing lots of people in the global South." This was reflected in my

interviews with workers at FEMA, the Red Cross, various agencies of the United Nations, and non-profit leaders in New York City. In personal interviews, two responders to Superstorm Sandy in New York City noted that the most affected neighborhoods were underrepresented in Big Data because their electricity was disconnected for several days following the storm—one interviewee quipped that if responders looked only at Big Data they would assume the hardest-hit areas were wealthy Manhattan neighborhoods rather than the more diverse lower-income neighborhoods on the Rockaway Peninsula.

Questioning Big Data's completeness in this way has implications beyond gaps in participation. Most importantly it has implications for the types of knowledges Big Data captures in humanitarian crises and emergencies. It sheds light on the distinction between what one in the site of a crisis is able to know, and what someone who is removed from that site is able to know about it. Thomas, a senior-level manager of a major U.S. emergency management agency, observed that factors motivating one's participation in Big Data are different for people with disparate geographies:

> They [the data coming from the crisis zone and from remote volunteers] are very different—and there are very different motivators for these people. For one it's, 'Help! I'm trapped in my frickin' house! And the roof's collapsed around me,' versus, 'I live in Texas, there was this big earthquake in Indonesia, and I want to help.' They're both important, but they're very different motivators. … The education, the affluence of the people that are working, and their own inherent social biases, are all things we have to think about, well beyond simple things like language issues.-(Thomas, personal interview, 2013)

For Thomas, then, Big Data exemplifies a collapse of the different forms of knowledge that result from different motivating factors. One directly impacted by an emergency has different knowledges and different motivators for communicating those knowledges. Big Data does not make these differences readily apparent, and Thomas therefore encourages critical reflection on Big Data knowledge expressions.

The knowledge produced through Big Data technologies, data, and practices is always partial and

reflects the geographical and social contexts of the people producing those knowledges. This is an important admission because the stakes are so high: if humanitarian organizations' practices and operations eventually come to be influenced by Big Data, the way they come to understand on-the-ground conditions will be impacted by these partialities. The humanitarians with whom I spoke seem to be partially cognizant of this, as expressed in their concerns and hesitations.

Situational awareness gathered through Big Data sources and practices, because it is thusly partial, is useful in much narrower ways in comparison with awareness gathered through other methods. Jeremy, a human rights lawyer engaged in digital humanitarianism debates, connected the partiality of knowledge with the practices used to "make sense" of Big Data:

> The problem with [a well-known digital humanitarian platform] is that it's not … designed to do the three things we need it to do to [be usable in a human rights abuses case]: one is accurate geocoding. The geocoding is arbitrary. And until [the platform's] geocoding isn't arbitrary, there's nothing I can do with it. The second thing is that it taxonomically distorts the data through categorization. … Categorization is forcing a level of pre-judgment that prevents the data from telling its own story. And that gets to the third thing. You never, ever want to append or amend a primary source that's digitally collected. Because when you do that, you don't know what its significance is, right? … You want [multiple] reports to cross-pollinate and to make sense in context. The problem is that with Ushahidi, that's where the dots come in. … The dots isolate the acts. They should be *domes* where acts can exist in context. Because right now you can't get relational. … You don't know how they relate. If someone reports a fire it's a fire. If someone reports a car bombing at the market where a fire took place - there's a relation. … Ushahidi is not a platform that allows me to do that, and neither is Tomnod.- (Jeremy, personal interview, 2013)

Jeremy thus contends that the digital humanitarian platforms designed to integrate Big Data signify the emergence of a new epistemology that embodies several significant limitations for use in his work. It

signifies a new epistemology insofar as it portrays events as discrete and isolated; knowledges as modifiable, categorizable, and abstractable; and locally-situated knowledges as best understood by those working remotely.

Big Data therefore in this case can be conceptualized as a framing of what can be known about a humanitarian crisis, and how one is able to grasp that knowledge; in short, it is an epistemology. This epistemology privileges knowledges and knowledge-based practices originating in remote geographies and de-emphasizes the connections between multiple knowledges.

Big Data as social relation

If Big Data can be conceptualized as a new set of practices and an epistemology, it can equally be interrogated for the new social relations it embodies. Big Data within digital humanitarianism produces social relations based on its discursive production of needy subjects and by impacting the material conditions of humanitarianism's subjects. These relations, discussed in more detail in this section, enroll values, norms, and privileges as has been shown in research on information technologies. However, these social relations differ from previous research in that the humanitarian context exposes particularly vulnerable populations, while the use of distributed information technologies exacerbates the knowledge politics dynamic and range of interests at play.

Big Data helps digital humanitarians produce discourses of subjects in need of digital humanitarian involvement. This is necessary for their work to be valued and used by formal humanitarian institutions, and constructs at least two such subjects. Notably, both discourses about needy subjects have originated from within the digital humanitarian community. The first subject is the crisis-affected person in need of humanitarian aid, which digital humanitarians promise to help deliver. For example, a crisis-affected community may use social media to communicate their knowledges of a disaster, and these knowledges, when collected, processed, and represented, help digital humanitarians produce the subject who needs digital humanitarian intervention. The second subject in need is the formal humanitarian community, who needs digital humanitarians to reduce costs and

increase speed and efficiency. These discourses typically represent the formal humanitarian community as unable to cope with pressures introduced by increased data flows and increasingly complex crises.

Big Data discourses assist in producing both subjects when digital humanitarians claim that Big Data constitutes the agglomeration of voluminous data sources that rely on digital humanitarian—usually volunteered—labor to process. Although the ability to communicate his organization's information to broad audiences (in a one-to-many fashion) more greatly benefits Kevin's emergency operations, he contends that having more social media users—what he calls "more sensors"—near the source of an emergency reporting information is a potential benefit of Big Data platforms like Twitter. In December 2012, digital humanitarian organizations were activated to help recovery efforts from Typhoon Pablo. The number of tweets from these "sensors", overwhelming for formal responders, helped justify digital humanitarian involvement. In a public blog posted to the Crisis-Mappers listserve, Meier (2012b) wrote:

> The United Nations Office for the Coordination of Humanitarian Affairs (OCHA) has just activated the Digital Humanitarian Network (DHN) to request support in response to Typhoo [*sic*] Pablo. They also need your help! Read on! … Given [the] *very* short turn around time, we only have 10 h (!), the Digital Humani-tarian [*sic*] Network needs your help! The SBTF has partnered with colleagues at PyBossa to launch this very useful microtasking platform for you to assist the UN in these efforts. No prior experience necessary. Click here or on the display above to see just how easy it is to support the disaster relief operations on the ground.

This sort of solicitation helps produce the dual needy subjects of digital humanitarian involvement. The people affected by Typhoon Pablo are indirectly implicated, as they are presumably producing Big Data and—again, presumably—stand to benefit from efficacious use of this data source. UN OCHA, however, is also constructed as in need of unpaid digital humanitarian labor. In the social relations that emerge from this subjectivity formation, the digital humanitarian community possesses the skills, resources, and requisite knowledges to effectively assist the needy subjects of disaster-affected communities and the formal humanitarian institutions. Put another way, this configuration obscures the funding, resource, and skills constraints causing imperfect humanitarian response, instead positing volunteered labor as "the solution." This subjectivity formation carves a space in which digital humanitarians are necessary for effective humanitarian activities.

Given the epistemological limitations discussed above, producing these needy subjects privileges the sorts of knowledges people geographically removed from a humanitarian crisis are able to possess. These knowledges are not directly impacted by the crisis in the same way as those located in the crisis zone; in other words, they are mediated through others' knowledges and communications. Those working remotely cannot know the direct human experience of the crisis, but must instead form their knowledges through the curated representations of those impacted directly. Within digital humanitarianism, the epistemologies privileged by Big Data are often data-centric and focused on correlations, rather than epistemologies highlighting qualitative understanding, communal and situated lay knowledges, and connections with social theory. Robert (personal interview, 2013) characterized this approach by saying:

> So that is where the really difficult questions are right now. They take more expertise than, say, your average hacker has; I mean, the folks that are here are people with PhDs and 10 or 15 or 20 years of experience in industry doing cutting-edge, innovative, advanced computing research and development, and I don't know of many other organizations—[with the exception of] academics like University of Colorado at Boulder—who have the resources to focus on these very difficult data issues.

Seen here is another route taken toward the construction of the Big Data digital humanitarian identity in relation to the needy subjects it serves. In this framing, professionalized knowledges are offered as evidence of digital humanitarians' ability to use Big Data to help *both* people in humanitarian crises and formal humanitarian institutions. Importantly, while digital humanitarianism has emerged partly because of its solicitation of non-expert, unpaid laborers, Big Data has introduced a new challenge to this because, as Robert suggests, collecting, processing, and representing Big Data requires specialized tools, expertise,

and often paid academic research. These relational identities are here leveraged in order to assist in the production of the needy formal humanitarian organization subjectivity: because Big Data requires substantial expertise and resources—which the digital humanitarian community purportedly has—the formal humanitarian sector is in need of digital humanitarian contributions.

There is less evidence that Big Data is engaged by formal humanitarian organizations to determine where to send material aid and aid workers. Most humanitarian managers expressed hope that eventually this option will be available to them, but that they currently do not use it in that manner. In the case where this becomes organizations' standard operating procedures, Big Data will constitute a material relation between the digital humanitarians who are able to influence to whom and where aid is directed, and the needy individuals who effectively request aid through Big Data practices such as Tweeting and sending SMS.

Conclusion: toward an integration of critical information technologies, Big Data, and digital humanitarianism

Proponents of Big Data conceptualize it as a new source of information that will "revolutionize" humanitarianism in a value-free development. On the one hand this can be seen as part-and-parcel of the hype that often surrounds new technologies and can be instrumental in their adoption. On the other hand, in this article I argued that a Big Data future is not inevitable, and would emerge embodying multiple forms of values and privileges. As a new set of practices, an epistemology, and a set of social relations, Big Data digital humanitarianism is imbued with social and political implications explored in this paper. Specifically, Big Data is constituted by profound changes in how data is collected, processed, and visualized; it is an epistemology that promotes the knowledges of people located distant from crises; and it privileges a professionalized, volunteer-based labor force. These implications are not limited in their effects to the field of digital humanitarianism, as they resonate with—and reinforce—broader political-economic and socio-political processes (Elwood et al. 2011; Leszczynski 2012). Such processes include, but

are certainly not limited to, continued struggles around knowledge politics and legitimacy (Burns 2014; Elwood and Leszczynski 2013), shifting understandings of scientific knowledge production (Dalton and Thatcher 2014; Crampton et al. 2013), and increased neoliberalization of humanitarian aid (Adams 2013; Hyndman 2009; Polman 2010). In other words, these processes take a form specific to Big Data digital humanitarianism, and exploring this case sheds greater light on these larger-scale processes.

My goal in this paper was to identify and characterize Big Data as it is currently unfolding in digital humanitarianism. By identifying and characterizing this trend we can better conceive of the limits and modalities of Big Data. Theorizing Big Data requires accounting for its limitations, perhaps even more imperatively than its affordances. Here I have suggested that attending disproportionately to Big Data's affordances has created a significant disjuncture between the discourses around Big Data on the one hand and its observed social and political impacts on the other. The ambiguous conceptual value of the term "Big Data" further exacerbates this disjuncture. Definitions and conceptualizations of Big Data are diverse and often contradictory, and this impacts the ways in which digital humanitarians see and communicate their contributions to humanitarianism through Big Data. I proposed three new dimensions to consider in conceptualizations of Big Data, which are intended to nuance and temper some of the grand claims of Big Data's affordances.

Key principles from critical and feminist GIS have here been leveraged to understand the limitations and impacts of Big Data. Further integration of principles from critical information technologies research will ideally seek to show how technologies shape and reproduce uneven social and political relations. This sort of research can have practical influence on how technologies are leveraged, working to ameliorate the potentially harmful implications of new technologies.

More broadly, research critiquing and situating the geographies of humanitarianism can be integrated into studies of Big Data digital humanitarianism. Conversations around technologies for development and humanitarianism overwhelmingly bring Western ideals into non-Western contexts, without considering the implications of this power relation. Critiquing these relations should be central to theories of information technologies, with the goal of rectifying and

ameliorating these implications. In other words, critique can open the possibility for new and better worlds.

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