Hacker Cartography: Crowdsourced Geography, OpenStreetMap, and the Hacker Political Imaginary

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Abstract

In this paper I trace the origins of "neogeography" (a constellation of new mapping practices and populations on the geospatial web) to its roots in computer hacker culture, notably through early mapping mashups, known originally as "map hacks". I argue that a return to the figure of the hacker—via the proposed concept of *hacker cartography*—offers a productive lens for understanding the affordances and limitations of participatory knowledge production on the geoweb. Drawing on theorizations of hacker communities and the "hacker ethic" in the literature, I explore how hacker politics (and their critiques) can be observed on the geoweb, using specific examples from OpenStreetMap. I argue that the figure of the hacker—a highly expert individual who nonetheless frequently contributes labor without financial compensation, often producing software and data for his or her own use—presents a fresh way to rethink the expert/novice, professional/amateur and producer/consumer axes that have frustrated geographers' theorizations of participation on the geoweb. I show how the utopian ideals of the hacker ethic offer a promising yet problematic answer to the desires of Critical GIS and Participatory GIS to create more empowered users of geospatial technology.

Introduction

Recent years have witnessed dramatic changes in the way computers are used to create, process, and display geographic information. New technologies such as map mashups, virtual globes, satellite navigation, and location based services have emerged alongside new mapping populations, where non-professional individuals and groups have new abilities to develop mapping software, create cartographic representations, and produce geographic content. The geospatial web (or geoweb) emerged alongside a rhetoric of ubiquity and democratization, much like the broader cyber-utopian ideology of "Web 2.0", whereby increased user participation would enable more empowered citizens. The geoweb promised that map making was now within reach of everyone, not just trained geographers using expensive desktop GIS software (Tulloch, 2007), but this promise has not always matched reality (Haklay, 2013).

In this paper I focus on one aspect of the geoweb, specifically the social dynamics involved in the "crowdsourcing" (Brabham, 2008) of geographic data and representations online. A variety of terms have been employed to describe these phenomena: ubiquitous cartography (Gartner *et al*., 2007), the wikification of GIS (Sui, 2008), new spatial media (Crampton, 2009), and neocartography (Cartwright, 2012; Liu and Palen, 2010), to name a few. Some of these terms have been proposed by academic researchers, while others emerged from these new mapping communities themselves. In this paper I will focus on three of the most commonly used terms: the geoweb, Volunteered Geographic Information (VGI), and neogeography. These overlapping terms do not have stable, widely-agreed-upon meanings, and while each term attempts to describe a specific aspect of the broader phenomenon, each has been enrolled to stand in for the whole.

The *geoweb*, as defined by Scharl and Tochtermann (2007) is the combination of geocoded data and mapping and analysis tools accessible over the internet. More recent scholarship, however, has broadened the definition of the geoweb away from a specific focus on tools and data to explicitly include the social practices and communities associated with new online geographic media (Elwood and Leszczynski, 2011). By contrast, *Volunteered Geographic Information* (VGI) was originally defined as geographic data created largely without pay by individuals who are generally amateurs (that is, without formal training in geography), in contrast to existing datasets created by professionals working within established frameworks (Goodchild, 2007). VGI as a phenomenon is enabled (primarily) by geoweb technologies that allow for easy collection and distribution of data; thus VGI can be considered a subset of the larger concept of the geoweb. However, like the term geoweb, VGI has been stretched to include software, cartographic representations, and associated practices (Elwood, 2008; Elwood *et al*., 2012).

The third term commonly used to describe the emergence of new mapping technologies and practices online, *neogeography*, emerged from outside the

discipline of Geography. Turner (2006) defines neogeography as a set of tools and techniques outside the domain of GIS and professional geography. Despite this definition's focus on the technological differences, most writing on neogeography has also addressed the emergence of non-expert map makers, or *neogeographers,* which are often conceived of as in opposition to the professional geographers who are associated with, by implication, the obsolete tools and practices of *paleogeography* (Sui and DeLyser, 2012). Neogeography is also sometimes used to refer to new geoweb mapping tools and techniques on their own, even when taken up by professional geographers (Boulos *et al.,* 2008; Rana and Joliveau, 2009). In this sense, neogeography could be seen as the geoweb-specific case of *produsage* (Bruns, 2008), the blurring of the traditional separation between geospatial data producer and data user/consumer (Budhathoki *et al.,* 2008; D. J. Coleman *et al.,* 2009).

Terms such as neogeography are also quite broad, referring to relatively unskilled VGI contributors but also to the high levels of skill required to develop new geographic software. At first, practicing neogeography required fair amounts of technical (if not geographical) knowledge; early neogeographers were often experts in their own field, usually the software industry. As geoweb tools have become increasingly user-friendly, geotagging photos, creating and sharing maps, and producing a range of VGI are now within reach of more and more users. Neogeography also includes a range of professional roles: some neogeographers undertake their activities on a completely voluntary basis, while others may be creating software or data for corporate entities like geoweb startups. In grappling with these distinctions, scholars have disagreed about whether the salient feature of neogeography is its amateurism (that is, people creating VGI as unpaid volunteers) or rather its position outside the professional discipline of Geography (institutionalized in academia, government and corporate GIS users). Goodchild (2009) contrasts neogeography with academic geography, implying that in addition to amateur map-makers, neogeography could also include new corporate actors such as Google who provide mapping tools that eschew or simply ignore many traditional GIS conventions; for example, he observes that mis-registered satellite imagery in Google Earth provides the basis for countless volunteered data points aligned—incorrectly—to a *de facto* "Google datum" (2007, p. 219).

A recurring theme in these discourses and definitions (not limited only to the terms geoweb, VGI, and neogeography) is the construction of various binaries—professional/amateur, expert/novice, producer/consumer—which are portrayed as blurring and collapsing (or, in some cases, thrown into new antagonisms). Inevitably, these binaries tend to be overly simplistic and not very useful as a descriptive tool. Some scholars have set up these binaries as orthogonal axes (Budhathoki *et al.,* 2008; Grira *et al.,* 2010), or as overlapping ranges along one continuum (D. J. Coleman *et al.,* 2009), but the multiple roles present within the geoweb remain difficult to reconcile. This fluidity of roles has also resulted in a perhaps necessarily diffuse use of terminology; if we were to attempt to synthesize

the ways these three main terms are used, we might, on the simplest level, conceive of the *geoweb* as an umbrella term—including tools, data, and practices—within which *neogeography* is the set of activities and new participants, and *VGI* is the data that emerges from these processes.

Beyond the mere descriptive uses of these various terms, political questions of democratization and empowerment are also intertwined with the terms used to describe these new phenomena. The nominal attributes of neogeography—the involvement of more citizens in mapmaking using more flexible and user-friendly tools—seem to satisfy many of the goals of Critical GIS and PPGIS. Miller (2006) suggested that map mashups might be a concrete example of the theoretical GIS/2 desired by Critical GIS scholars (Schroeder, 1996; Sieber, 2004). Similarly, (Tulloch, 2008) asked whether VGI is in effect a form of PPGIS. By and large, however, critical GIS scholars have understandably been reluctant to embrace either VGI or neogeography, arguing, respectively, that "Volunteered" Geographic Information implies an "altruism that may not be present," (Elwood, 2008, p. 175) and that the "neo" in neogeography works to establish the inevitability of technological change, and to evade responsibility for its social implications (Leszczynski, 2014). Yet, it is precisely the fraught and disquieting nature of terms like VGI and neogeography that make them useful windows into these complex phenomena, when used cautiously and with self-awareness.

Another term that is similarly loaded with political baggage and shifting interpretations is "hacker." The first mashups originated in hacker culture and were known at the time as "map hacks," following the original definition of a hacker as a curious tinkerer or problem solver. The terms "hack" and "hacking" were used frequently in media coverage of the mashup phenomenon (Singel, 2005; Terdiman, 2005), featured in the titles popular technical books (Erle *et al.,* 2005; Gibson and Erle, 2006) and also in the academic articles of this time (Crampton and Krygier, 2005; Crampton, 2006; Monmonier, 2006). As soon as Google Maps was launched in 2005, software hackers began reverse-engineering Google's JavaScript code in order to add their own content to the map. Thus, there were elements of these "map hacks" that reflected the mainstream interpretation of "hacker" as someone who illegally infiltrates computer networks to cause mischief or damage. Specifically, the first user-created web maps (such as Chicago Crime and HousingMaps, both now defunct) required reverse-engineering existing JavaScript code, and screen scraping content. These early mashups or map hacks also contained the transgressive act of remixing existing data sources and services in new ways, sometimes in violation of Terms of Service agreements. In fact, the term "mashup" was a concept drawn from music remixing, inspired by the particularly high profile music mashup The Grey Album by DJ Danger Mouse in 2004, (M. Batty *et al.,* 2010) itself the target of a copyright-infringement lawsuit initiated by music publisher EMI (Werde, 2004).

Within the first few years, however, the mashup as a technique became more mainstream (Scharl and Tochtermann, 2007), increasingly sanctioned by data

providers and requiring less technical expertise. As early as June 2005, with the launch of the Google Maps API (Application Programing Interface), mashups began to be mainstreamed into Google Maps. Other mapping providers soon followed Google's lead, and increasingly the functionality previously possible only through reverse-engineering and screen scraping became supported via APIs. Gradually, the use of the term "map hack" has fallen out of common usage, perhaps because of the negative connotations of the term, or perhaps because it is no longer necessary to hack the JavaScript code of Google Maps in order to create a mashup.

Yet the term map hack is only obsolete in this very narrow sense; I argue that a "hacker ethic" is still active in many online mapping projects in a variety of ways. Notably, Haklay (2013) also revisits the concept of hacking *vis-a-vis* neogeography, to theorize different levels of technical engagement with geoweb technology. I hope this article provides a useful complement to Haklay's work; instead of focusing on *hacking*, here I will focus mostly on *hackers*, investigating the social aspects of what it means to be a hacker and using the ideology of the hacker ethic as a lens to understand the complexity of neogeographical practices in the current environment.

Specifically, the concept of the hacker gives us more specific terminology to distinguish internal differences within neogeography and VGI, and also provides an escape from the analytical trap of the professional/amateur, expert/novice, and producer/consumer binaries without collapsing them. In this paper I propose the concept of *hacker cartography* as a tool for theorizing the diverse affordances of the geoweb and the various technical and social registers in which individuals participate in crowdsourced map-making. I define hacker cartography as geoweb-based practices of collaboratively creating and curating crowdsourced geographic data and representations, using a mixture of open software and repurposed tools and data. Hacker cartography is a practice of *amateurs*, but I use that term not in the sense of naïvety or lack of experience, but to suggest the sense of passionate and knowledgeable individuals who simply lack official titles or formal training in map making.

In subsequent sections I will further elaborate on this definition; like the *geoweb*, *VGI*, and *neogeography*, hacker cartography is a concept with difficult to define boundaries, and one where the social practices of knowledge production cannot be disentangled from the technical infrastructure or the geographic data itself. However, I do not intend hacker cartography to operate as a synonym for neogeography or VGI, nor as part of any binary between professional and amateur modes of online map making. Rather, I suggest that the figure of the hacker possesses attributes of both the professional and the amateur without falling neatly on a continuum between the two. Positioning hacker cartography as a third space in a conceptual field beside professional and amateur map makers allows for a fuller understanding of the various possible roles within VGI, neogeography, and the geoweb in general. I do not intend to adopt the normative ideals of the hacker ethic, to argue in favor of a hacker cartography drained of political context. The figure of

the hacker exists within a field fraught with contradictions, and I enroll the concept of the hacker not to valorize nor demonize new mapping populations, but rather to throw light on the messy relationships already present within the phenomena of crowdsourced map-making.

In this article, I begin with an overview of how computer hackers understand themselves, and how they have been theorized in the academic literature, with a specific focus on how hackers position themselves in relation to existing structures of expertise. Having established what is meant by "the hacker", I then propose the concept of hacker cartography as an alternative category of geoweb activity outside the professional/amateur axis. Finally, I identify the origins of neogeography and the geoweb in hacker practices, and describe in detail how one high-profile project, OpenStreetMap, illustrates many of the tensions present within hacker cartography.

Hackers and hacking

The hacker ethic

The hacker is not a unitary and uncomplicated figure; to understand how the hacker relates to crowdsourced cartography, it is first necessary to examine the history and range of hacker archetypes. Current mainstream understanding of a hacker is someone who illegally breaks into computer networks to steal information or otherwise cause mischief and destruction. Among those who would call themselves hackers, however, the term is used more broadly (and in a way that hews much closer to the original definition of the term) to describe any hobbyist who engages in curious tinkering or creative problem solving. A hack can mean both an exceptional feat of programming, or a quick-and-dirty yet skillful solution. Hackers are not limited to computer software: to hack could also refer modifying computer hardware, or the creative re-use of any existing technology, practices that span from 1950s garage tinkerers and model railroad enthusiasts to today's reinvigorated DIY (or Do-It-Yourself) movement and contemporary Makers (Greenberg, 2005; Leadbeater and Miller, 2004; McFedries, 2007).

Hacking is more than a simple repertoire of practices associated with technology; these activities are embedded in suite of cultural practices and normative beliefs about how individuals ought to live and act *vis-a-vis* technology. One of the earliest theorizations of the hacker was written by Steven Levy (1984) who described the *hacker ethic*—that is, what hackers thought it meant to be a hacker, particularly in the early decades of computer technology in the 1950s and '60s. The fundamental tenet of the hacker ethic is that information should be free, and that access to computers should be unrestricted. To that end, hackers exhibit a preference for creating open systems and disassembling and reverse-engineering closed ones. Hackers see the creative reuse and repurposing of technology as a hands-on way of learning about the world, and of becoming self-directed and self-reliant individuals. In this same vein of valorizing the independence of the individual, hackers also believe that information should be decentralized and authority mistrusted. This mistrust of authority also structures hacker ideas about

socialization and self-organization within hacker groups; the community of hackers presents itself as a meritocracy wherein hackers should be judged on solely on one's hacking skill, "not bogus criteria such as degrees, age, race, or position" (Levy, 1984, p. 35). Finally, hackers believe that hacking, in itself, can make a better world through the free exchange of information and through the spread of hacking skills. Hackers believe that everyone could benefit "by approaching the world with the same inquisitive intensity, skepticism toward bureaucracy, openness to creativity, unselfishness in sharing accomplishments, urge to make improvements, and desire to build as those who followed the Hacker Ethic." (Levy, 1984, p. 40)

Himanen (2001), however, conceives of the hacker ethic more narrowly, emphasizing what might better be called the hacker *work* ethic. Contrasting the hacker ethic with the protestant ethic, Himanen generalizes away from hackers *per se,* arguing that the hacker's feelings towards work (that it should be fun and intellectually stimulating) is a model for all forms of work in the information age. Himanen's view is not necessarily in conflict with Levy's, but for Levy, the hacker ethic is much more than just a work ethic, it is a worldview. It is Levy's more extensive definition of the hacker ethic that provides the foundation for this article, and for the further theorizations of the hacker described in the following section.

Hacker politics

Later scholars have built on Levy's framing of the hacker ethic, focusing on the cultures of hacker communities, and how hacker conceptions of sociality are informed by their beliefs about technology. Certainly, hackers can be solitary figures operating in isolation, but more often hackers are embedded in networks of friendship and affinity organized through shared online discussion forums or surrounding the collaborative development of a piece of software. Coleman and Hill (2005) describe, for example, how discussions that surround the actual production of code—including parallel mailing lists as well as text-based comments embedded in the code itself—are crucial sites for strengthening contributors' ethical beliefs in free software and in consolidating the group's shared identity.

For hackers, the free sharing of software code is not only their material objective and ethical norm, but also acts as a metaphor for the free exchange and debate of ideas. Drawing on Warner's (2002) conception of multiple publics organized and instantiated through their own discourses, Kelty (2005) describes the free software community as a "recursive public" where hackers argue about technology, but also through it. Thus, an idea crucial to the formulation of hacker publics is that the "laws" that govern free software can also govern communities. The Free Software movement (described in the following section) is founded on the idea that writing code is a speech act; this free speech dimension of hacker culture has seen it enrolled as part of a broader social justice movement, with its rhetoric expanding beyond hackers to diverse groups worldwide (Schoonmaker,

2007; Sullivan, 2011). But beyond this shared belief in freedom of speech and in the inherent goodness of technological progress, in the classic conception of the hacker ethic, hackers see themselves as apolitical. Fundamentally, the free flow of information is the hacker's only political stance (E. G. Coleman, 2004). In recent years, some hackers have begun to mix the hacker ethic with explicit political activism, resulting in the offshoot practice known as *hacktivism* (Jordan and Taylor, 2004; Taylor, 2005).

The hacker ethic of decentralization and mistrust of authority as noted by Levy contributes to the hacker ideal of flat, non-hierarchical organization. Prominent hacker Eric S. Raymond (2001) characterizes the difference between the hierarchical direction of proprietary software companies versus the chaotic practices of hackers as "The Cathedral and the Bazaar". Here the bazaar-style (dis)organization of hackers and open source software is seen as more nimble and dynamic, as well as more democratic. The bazaar model also includes a focus away from linear software development to a more *ad hoc* approach, and a focus less on finished products to artifacts that are continually in development (sometimes termed "perpetual beta") (Bruns, 2008). However, despite this ideal of participation equality, open source projects frequently exhibit powerful leaders known as "benevolent dictators", of which the prime example is Linus Torvalds, the creator of the Linux operating system (Berry, 2008). These benevolent dictators are unelected and usually have no formal power, but lead by consensus and hegemony. Contemporary crowdsourced knowledge communities, which are frequently overtly modeled on open source principles, also tend to develop their own benevolent dictator roles, for example Wikipedia's founder Jimmy Wales (Bruns, 2008; Konieczny, 2010; Reagle, 2007), or OpenStreetMap's founder Steve Coast. Inevitably, hackers must navigate a variety of customs and relationships as they are socialized into (or sometimes excluded from) hacker communities (Ducheneaut, 2005).

The egalitarian ideals of the hacker ethic also posit a relatively disembodied subject, and that the free flow of information on the internet can liberate individuals from the constraints of physical space. "We exist without skin color, without nationality, without religious bias", states the 1985 online text "The Conscience of a Hacker" (also known as the Hacker Manifesto, not to be confused with Mackenzie Wark's 2004 book of the same title), but in reality hackers are overwhelmingly male, white, and from privileged economic positions. For example, Adam (2004) argues that many women who wish to join hacker communities are deterred by the unwelcoming culture of "frontier masculinity" that pervades most hacker groups, while Thomas (2002) describes hacking as an extension of "boy culture" taken online. Even the way in which "openness" is constructed in open source communities privileges certain kinds of knowledge and modes of communication that systematically disadvantage women (Nafus, 2012).

Also, as Berry (2008) notes, the illusion of immateriality denies hackers' very real embodied material needs. Free and open source software exists largely outside

of the capitalist mode of exchange, but most hackers create this software during their spare time away from their regular employment in proprietary software industries. In this sense, hacker practice is a necessarily parasitical activity, despite the apparent bright lines dividing free and open source software from proprietary software in the purely digital field.

The parasitic nature of hacking is one of the many complications apparent within the hacker ethic of decentralization and anti-authoritarianism. Early hackers from the 1950s to the 1970s—the "old school" hackers identified by Thomas's (2002) periodization—worked with mainframe computers at university computer labs funded primarily from the US military's Advanced Research Projects Agency (ARPA). The anti-authoritarian streak of the old school hackers must be understood within this context. Old school hacking was perfectly content working under an organization as centralized as the US government; the era of the "true hackers" (Levy, 1984) only came to an end during the 1970s and 1980s as many software developers abandoned hacking and moved to lucrative jobs in the corporate sector. In this new context of proprietary code and closed systems, a culture emerged of "new school" hackers (Best, 2003; Thomas, 2002) with their own parasitic practices of breaking into computer networks to satisfy their curiosity and to liberate information. Finally, Wark (2004) offers a neo-Marxist interpretation and reversal of the tense relationship between hackers and the corporate sector, casting hackers in the mold of a new proletariat, struggling with a "vectoriat" class that controls and profits from hackers' productive forces.

Free/Libre and Open Source Software (FLOSS)

Meanwhile, the legacy of old school hackers can be traced to the founding of the "Free Software" movement in the 1980s. Originally formulated by Richard Stallman, free software is a direct response to proprietary software, emphasizing the users' freedom to use, edit, and distribute software. For this reason, "free/libre software" is often used, to emphasize software freedom (*libre*) rather than cost (*gratis*), although free/libre software is generally free of cost as well. The ideology of free software directly links the freedom of information with the liberation of human potential, as Stallman articulates: "I consider free software a human right, and thus a moral norm" (Berry, 2008, p. 155). "Open Source Software" (OSS) on the other hand, is an alternative branding concept developed by Eric S. Raymond, who felt that the licensing restrictions and the explicitly political discourse surrounding "free software" worked against the commercialization of its technique. Instead, the rhetoric supporting OSS emphasized its practical benefits, abandoning Stallman's techno-utopianism. As Raymond states, "Open Source is not particularly a moral or a legal issue. It's an engineering issue. I advocate Open Source, because very pragmatically, I think it leads to better engineering results and better economic results" (Berry, 2008, p. 170). Unsurprisingly, the open source branding emerged around the time that IBM and other corporations became interested in integrating free software into their products. The acronym FLOSS, Free/Libre Open Source

Software, also sometimes written simply as FOSS, is often used to recognize both of these histories, but these divisions remain within the hacker community.

FLOSS cannot be understood without also examining the licensing context that partially determines its use. FLOSS licenses use the pre-existing legal framework of copyright to release all rights to the software, with the only condition being that the software and any derivative versions are released under the same license. This inversion—in a sense, a hack—of traditional copyright law (yet, still retaining the full force of the law) is known as "copyleft." These licenses are sometimes called "viral," because of the way every derivative or combined work becomes "infected" by the same license. Copyleft licenses do not necessarily preclude others from profiting from the licensed product (for example, the Creative Commons class of copyleft licenses allow, by default, commercial uses of the creative work), rather, they simply require that any improved version of the code or data be made available freely to others. Here the range of possible legal arrangements surrounding hackers' digital production mirrors the ideological fractures within the hacker ethic itself.

Hacker practices

Even in the academic writing on hackers, Coleman and Golub (2008) argue that the portrayal of hackers is generally quite binary: they are portrayed as geniuses and creative heroes, or as selfish criminals. Other scholars have identified differences within the hacker community (Best, 2003; Levy, 1984; Thomas, 2002), but these have largely been framed as periodizations, where different hacker practices rarely coexist temporally. As an alternative to these conceptualizations, Coleman and Golub suggest that there are multiple overlapping hacker practices and ethics that exist simultaneously, frequently even within the same individual. In particular, they identify three ethical practices or genres:

The first, which they call "Crypto-freedom and the politics of technology" is a strongly technolibertarian view of hacking. These hackers believe that individuals have the responsibility to protect their own information and privacy through cryptography. In this genre, strong privacy protection and personal control of software code are seen as the basis for a democratic ideal of self-reliant, autonomous subjects. These crypto-hackers see little use for notions of information held as a commons. Their second genre, "Free software and the politics of inversion", reflects the more utopian techno-collectivist ideology of free software (as described earlier). This genre also features an emphasis on the elegance of code, because FLOSS hackers are more willing—ideologically compelled, even—to share their code with others. The third genre, "The underground and the politics of transgression", aligns with Thomas's (2002) new school hackers who believe that information should be free, and that therefore they should liberate it, to make it free by illegally breaking into computer networks. Unlike the first two genres which value autonomy—individual autonomy in the first case, and collective autonomy in the second—the third genre is more parasitical, depending on existing networks,

and reworking existing software. This third category also overlaps with the offline hacker practice of tinkering with and re-engineering physical objects.

As stated above, these are not exclusive categories, and these internal tensions within hacker culture continue to be worked out both on the level of the individual and within hacker communities. In the following section I will define hacker cartography relative to professional and amateur cartography, drawing primarily from the characteristics shared generally across all hackers as defined by Levy (1984); however, in the final section a case study of one specific hacker cartography community—that of OpenStreetMap—reveals a heterogeneity of practice not unlike that articulated by Coleman and Golub (2008).

Professional, amateur, and hacker cartography

As stated in the introduction, I propose the figure of the hacker as a third alternative outside each of the amateur/professional, novice/expert, and user/producer axes frequently employed when analyzing the phenomena of neogeography and VGI on the geoweb. These pairs of terms each emphasize different aspects inherent diverse practices of geoweb mapping, revealing a number of significant and often conflicting implications arise about *who* creates representations of space, but also *how* these representations are created, managed, and controlled, and for what purposes.

Professional cartography

The professional cartographer is the figure we traditionally associate with mapping, using tools like desktop GIS, but also through the production of web-based maps (thus firmly on the producer side of the user/producer axis). These maps are usually underwritten by a governmental, educational, or corporate body, for the specific needs of those entities or as products provided or sold to the public. Professional maps are based on data that has been vetted for accuracy and completeness (to some extent), and the data used and produced by the professional is intended for specific tasks and at specific scales. Similarly, the underlying data is usually licensed to restrict its availability to certain people and particular uses. For all these reasons, professional mapping requires a high level of expertise in handling both data and technology.

Amateur cartography

The amateur mapper online is a figure often defined solely in contrast to the professional, hence the development of terms like "neogeography". Instead, I will try to define the amateur by what it does, rather than what it is not. The amateur role produces maps with available online tools such as Google MyMaps, using pre-existing data as a basemap or, in the case of mashups, also as the map's content. The fact that amateurs can produce maps at all is one of the most significant developments of the geoweb era, and yet amateurs lack the skills and expertise to create new mapping tools, or to fundamentally contribute to the base data upon which they make their mashups. Thus, while amateurs are moving towards the

producer end of the spectrum, they remain primarily users of mapping tools and data.

Hacker cartography

Unlike amateur cartography, hacker mapping includes active technical engagement that can operate at multiple levels (Haklay, 2013); hacker cartography is involved in the production of new thematic data as well as basemaps and tools that can be used by others. Like amateur mapping, hacker maps are produced for non-official uses, but they may map the same subject matter as professional maps, creating alternative framework data. Hacker mapping also retains control over the accessibility of maps and data, using copyleft (creative commons) licenses that encourage or require reusability and sharing of the data, unlike the products of amateur cartography which are, in most cases, legally owned by the corporate provider that hosts the map. Thus, while hacker cartographers are rarely paid for their efforts and are not "professionals", the data licenses they produce offer an alternative economic model to professional cartography, something that amateur cartography makes no attempt to do. Finally, the hacker approach to data quality accepts that some inaccuracies may occur in the data, but assumes that any errors will be fixed through collective effort. This is a stark contrast with professional mapping which requires a certain level of accuracy and enforces this requirement by restricting data creation to a small number of approved contributors, or amateur mapping which is open to anyone but contains no means of assuring accuracy.

While this collection of traits shared by hacker cartography is enough to distinguish it from professional or amateur cartography, the internal differences within the field of hacker cartography are often just as striking. As we have seen in the previous section, hacker culture contains multiple overlapping and sometimes inconsistent ways that individuals and subgroups interpret and act on the ideals of the hacker ethic. Similarly, multiple strains of hacker cartography can be found contesting the same space outside the poles of professionalism and amateurism. Some of the shifting manifestations and internal tensions within hacker cartography even occur within a single project, as will become apparent in the following section, where I briefly outline the origins of hacker-inspired map making and present the case study of OpenStreetMap, perhaps the most notable example of hacker cartography operating today.

Hacker cartography case study: OpenStreetMap

While the term "map hacks" is no longer commonly used, examples of hacker cartography haven't disappeared; rather, in parallel with the mainstreaming of Google Maps mashups, the geoweb has witnessed the continued growth of OpenStreetMap, a project founded in 2004, coincident with the dawn of map hacks and mashups. OpenStreetMap represents the ascendency a specific genre of hacker practice—derived from the techno-utopian ideals of free software identified by Coleman and Golub (2008)—at the expense of the more transgressive genre of map hacks and mashups. OpenStreetMap takes raw data submitted by volunteers in the

form of GPS tracks or traced aerial imagery, and synthesizes it into complex geographic data through collaborative filtering and editing of volunteered information. Unlike the mashups and map hacks built parasitically on Google Maps, OpenStreetMap represents a practice that is much more internally collaborative, but autonomous from any other existing geoweb project.

The OSM community exemplifies the ethical norms—and internal contradictions—of FLOSS and hacker communities, translated into the geospatial field: it believes geographic completeness and accuracy can be achieved using an open source ethic of mass participation, it espouses an ethic of self-learning and an ideal of meritocracy based solely on one's contributions, it believes that the freedom of information is intimately with the creation of liberal democratic subjects, and it negotiates these discourses through a complex interaction of data, code, and legal and social constructs. But despite these shared beliefs, there are ongoing struggles within the community over the ways in which these beliefs should be put into practice. I will specifically explore four themes where different notions of the hacker ethic are being worked out within the OpenStreetMap community. First, whether OSM should involve the parasitical re-use of tools, data, and services, or whether it should be autonomous, rejecting external authority, and building only on its own tools and data. Second, whether the value of hacker cartography lies in the self-directed work of individuals, or the collective decision making of a community. Third, how the OSM community deals with the contradiction between their democratic ideals and inherent elitism of online culture and complex technology. Fourth, the legal debates about which forms of data licenses best serve the hacker ideals of empowering users and freeing information. In the following sections I illustrate these themes using quotes from active contributors to the OSM project, drawn from blog posts, electronic mailing list messages, and other public statements.

Autonomy versus parasitism in hacker cartography

OpenStreetMap was founded with the desire for a strongly autonomous copyleft map that was not derived from any other copyrighted maps. Thus the nascent OSM community embarked on the massive undertaking of building a map of the world from scratch, using nothing but GPS traces and direct observation of the environment. Importantly, this was a social (and embodied) process from the beginning: much of OpenStreetMap's initial data was collected through the practice of "mapping parties," where groups of volunteers would walk around the city carrying GPS receivers, then work together to build a digital map on top of these GPS traces.

However, the OpenStreetMap community also expresses the hacker impulse to reuse existing raw materials in new ways, as long as the licensing of those materials does not compromise the autonomous copyleft status of the project. Much of the earliest mapping in OpenStreetMap was aided by the use of scanned, out-of-copyright Ordnance Survey maps, and low-resolution public domain

satellite imagery from NASA's Landsat satellites, which allowed volunteers to trace the shapes of geographic features without having to visit them physically. Later, the project formed alliances with corporate mapping providers to gain access to higher resolution aerial images (from Yahoo! initially, and more recently Microsoft's Bing Maps). Fundamentally, even the use of GPS to collect geospatial data was a creative reuse of a technology originally developed by the US military (much like the internet) that had been opened up for commercial purposes. OSM's developers also reverse engineered Google's unique map projection and method of serving tiled maps over the internet, another case where OSM adopted a pre-existing *de facto* standard rather than inventing their own approach.

OSM mappers also reuse existing data sources by importing public domain datasets where available from local and national governments. However, these data imports have been highly controversial among some OSM contributors who feel that imports undermine the development of strong local mapping communities. Frederik Ramm argues

> that OSM is part of a greater movement of collaborative productivity, where people all over the world can and do join forces to create something great, something of value. […] I believe that in 40 years, probably even in 15, hardly anything of the data we have collected will retain much value - but we will have been part of a great development, and mankind will be the better for it. […] will OSM, instead of being the social endeavor of "a great map that people made themselves", then be the technical challenge of "the geo database where a few clever guys managed to combine lots of existing data"? (Ramm, 2012)

This emphasis on the *process* of mapping rather than the end product parallels many aspects of the hacker ethic discussed earlier, but here it comes into conflict with the hacker impulse to tinker with existing data sets and achieve a functional map as soon as possible.

Motivations for ad hoc mapping: individual entertainment or collective goals

OpenStreetMap has been called the "Wikipedia of maps", and like Wikipedia, most of the data is created by volunteers who are also amateurs (although not always novices—many volunteers are passionate amateurs who know a significant amount about the subject at hand). As such, OpenStreetMap possesses many strengths (but also weaknesses) in common with projects like Wikipedia, such as a rapid response time and a great potential depth of detail. OpenStreetMap's rapid update cycle means that edits show up on the map almost instantaneously. This responsiveness feeds directly into the hacker desire to satisfy their curiosity and express technical mastery by fixing things; an OSM user can immediately fix any errors they encounter, rather than waiting for someone else to do it or do have their edits approved by some external authority. OSM's agile mode of development means that the project is well positioned to respond to natural disasters that require immediate updates to the map, such as OSM's role in crisis mapping after the 2010

earthquake in Haiti (Zook *et al.,* 2010). Similarly, OSM contributors have taken advantage of freely-licensed satellite imagery to remotely map conflict zones such as Baghdad (M. Batty *et al.,* 2010) and Gaza (Chilton, 2009) that were absent from corporate map providers, although due to lack of on-the-ground knowledge such attempts are inevitably incomplete (missing crucial attribute data, such as street names).

These varying levels of completeness mark a fundamental difference in approach between hacker cartography and professional mapping: rather than waiting for an accurate, professional map to become available, hacker cartographers believe a quick and dirty—yet still useful—map is better than none. As OSM founder Steve Coast explains,

> Data is collected in an *ad hoc* and undirected manner by volunteers worldwide. These volunteers use an open tagging system to classify data as they see fit, instead of a hierarchical top-down ontological system. This leads to many benefits such as allowing mallets to map what they want, when they want. This openness is key to putting as few barriers as possible between mallets and the map. (Coast, 2011, p. 4)

This folksonomic style inevitably results in some features getting tagged and retagged, often incorrectly (Mooney and Corcoran, 2012). To a GIS professional, an *ad hoc* approach is a recipe for error and inefficiency, but from the OSM point of view it's just the opposite:

> The sociality of OSM is its biggest strength. The intricacies of maps, tags, places are discussed in minute detail, and are ultimately the result of conversation, not top down dictate. The result are maps that are more expressive for more situations than any other platform. (Maron, 2012)

Maron's sentiment echoes Eric Raymond's view, cited earlier, that open source software is pragmatically better precisely because of the amount of people who can view and modify the source code. Both Coast and Maron are celebrating OSM's lack of hierarchy, but on a deeper level the two quotes reveal different competing conceptions of hacker sociality: Coast's statement betrays elements of a libertarian view that the best mapping occurs in the absence of restrictions or oversight, in contrast to Maron's collectivist argument that a strong community provides the best oversight.

Lacking guidance from a hierarchical organizational structure, OpenStreetMap exhibits a kind of *laissez faire* mapping, where contributions are made solely according to contributors' personal interests. Given that OpenStreetMap has no equivalent of Wikipedia's notability rule[2], the door is open to a potentially unlimited level of detail. In some areas, contributors have mapped levels of detail well beyond that available in commercial products like Google

2 http://en.wikipedia.org/wiki/Wikipedia:Notability

Maps, adding features such as mailboxes, bicycle parking racks, or individual trees in a park. What OSM has in common with Wikipedia, however, is that this depth of detail is highly uneven. In an ideal liberal world of democratic equality, such an *ad hoc* approach would eventually produce a complete, high-quality map everywhere in the world; in practice, however, there are strong spatial differences in the level of completeness in OSM data, and these differences correlate with differences in economic indicators (Haklay, 2010a). As the founder of OpenStreetMap, Steve Coast has said: "Nobody wants to do council estates. But apart from those socioeconomic barriers—for places people aren't that interested in visiting anyway—nowhere else gets missed" (Haklay *et al.,* 2008, p. 2029). In a user-led produsage environment where contributors only map things according to their interests—and according to proximity, a problem Haklay (2010b) calls "the tyranny of place"—then any skew in the demographics of OSM will produce skewed representations of geography.

Negotiating openness and exclusivity, collapsing experts and amateurs

The OSM community is predominantly European, highly educated, and overwhelmingly male (Budhathoki and Haythornthwaite, 2013), characteristics shared with FLOSS and hacker communities, disparities which are aggravated by many of the same causes. As Kate Chapman, an activist with the Humanitarian OpenStreetMap Team, writes:

> a few major barriers within the OpenStreetMap community are arcane communication methods which are only friendly to technical people, the loud hostile voices of a few towards organizational change and cultural barriers that almost require fluency in English to really participate in the greater community. I believe these issues are what leads to new contributors leaving before they really got started and not very many women participating in OpenStreetMap. (Chapman, 2012)

Stephens (2013) shows that this lack of diversity manifests in what features are represented in OSM's database, where "spaces of care and nurture that are associated with feminized skills garner less attention than the facilities where women are commodified (strip clubs, brothels, etc...)" (2013, p. 991), further alienating women who might otherwise join the project.

Lin's analysis of OSM contributors (Lin, 2011) found that 13 of 16 respondents had Information Technology (IT) background, and the other three worked in GIS. While this is not a representative sample, as Lin's respondents are drawn from the most highly motivated OSM contributors (those who would attend the annual conference), these results suggest that participating in OpenStreetMap is still highly technical endeavor. The "average" person without a technical background might find it quite difficult to participate in OSM beyond the most basic level. But it is also significant to note that some OSM mappers are not in fact amateur geographers: many do work with GIS professionally. This complicates the assumption that OpenStreetMappers are all amateurs, but is a finding in line with

the complexity of hacker and FLOSS communities: many hackers have "day jobs" as professional programmers. Thus, OSM's uneven standards of quality and idiosyncratic data structures don't necessarily indicate an ignorance of professional mapping techniques; some GIS professionals appear to be making a conscious choice to operate according to different standards when mapping as a part of OSM, but without necessarily forgetting their disciplinary training. "People were not inclined (and too eager to get started with mapping) to spend their time making up a catalog of objects to map, and existing standards were deemed too complex." (Ramm *et al.,* 2010, p. 58) Instead of betraying an unawareness of expert tools, the design of OSM's early tools and data models aimed to be, in true hacker fashion, "the simplest thing that could possibly work." (Ramm *et al.,* 2010, p. 58)

The legal terrain of hacker cartography and the politics of data ownership

OpenStreetMap uses a copyleft license to share its data, which requires that anyone who modifies OSM's data also has to share their modifications under the same license, and that any new contributions be compatible with that license. The intent of the license is to protect the openness of the data, but the attendant restrictions have proven to be a high burden that end up deterring many would be allies. As Chapman states:

> OpenStreetMap has a different goal than [crisis mapping] groups, the goal can be summed as "create a free map of the entire world". That aim though is key, it isn't "to create a free map for crisis response" or to "support humanitarian work with a free map." This difference in ambition can sometimes cause confusion between those joining the OSM community because they want to help with crisis response. (Chapman, 2010)

For most of its existence, OSM has licensed its data using a Creative Commons license; however, since the Creative Commons suite of licenses were designed for media content such as images, audio, or text, it was unclear whether these licenses were appropriate for the contents of a database such as OpenStreetMap. Applying Creative Commons to OSM contained two significant challenges: First, do the same viral restrictions on redistributing information apply to the OSM data as they do to graphical representations—that is, maps—generated from that data? Second, how can the authorship be properly credited within a database that may contain an unlimited number of individual authors? In response to these problems, OpenStreetMap worked with the Open Knowledge Foundation to develop a new copyleft framework, the Open Database License (ODbL)[3]; thus, much like the Free Software hackers before them, the OSM community has found itself forced to engage in "hacking" legal structures to create stable conditions for their technological and social aims. Yet the OpenStreetMap project's quest for legal stability produced a protracted period of uncertainty during the multi-year process

3 http://opendatacommons.org/licenses/odbl/

of creating the new license and designing plans for the license changeover (P. Batty, 2009; Watters, 2011), which occurred on April 1, 2012. The final changeover required contacting every contributor and having them check a box to relicense their data under the new ODbL terms, followed by a multi-stage process where contributors who disagreed or failed to respond would have their "dirty" contributions removed from the database.

Thus, while the license change was presented as a way of strengthening the community through technical and legal changes, the process of relicensing the data and seeking consent from contributors was also a way of strengthening—and reconstituting—the community through social processes, much in the same way that FLOSS and hacker communities formulate shared ethics and construct unanimity through inclusion and exclusion as much as through discussion, debate, and code (E. G. Coleman and Hill, 2005). In this way, OSM's license changeover was an exercise in purging incompatible contributions and, in a sense, incompatible contributors.

While the fastidious process of maintaining and developing copyleft licenses is intended to prevent the exploitation of OpenStreetMap's database by corporations who would not give back to the community, these licenses are unable to prevent hacker practices from being co-opted and reworked by outside organizations. Thus, not unlike the translation of "free software" from a utopian, collectivist concept to the pragmatic, business-compatible concept of "open source", the dominant commercial web map provider Google has adopted OpenStreetMap's crowdsourcing approach as an effective way of creating and maintaining a global geographic data framework. In 2008 Google launched their Map Maker product in select countries (Katragadda and Jain, 2008) gradually rolling it out worldwide and replacing the base data on their default maps with this crowdsourced information. Like OpenStreetMap, Google Map Maker allows any user to add data or update information on the map (although unlike OSM, it includes a system of professional oversight by experienced members with official administrator privileges). However, while the map can now be edited and improved by amateurs, the raw data they create cannot not shared or distributed. Google also borrowed the concept of mapping parties that OpenStreetMap developed (Maron, 2011), sending a Google-branded van around countries in the global south and teaching local citizens how to add to the Google's map. Participants in these mapping parties get Google t-shirts and a diploma, they don't own the data they have produced, Google does. Google's volunteers gain prestige and the satisfaction of mapping, but are invited into a community in which they can never be fully included (Boulton, 2010). The slogan of Map Maker, "Map Your World", differs significantly from how it might be phrased under a hacker ethic: "Take Ownership of the Map." However, as is the case with computer hacker culture, the entire ethic of hacker cartography doesn't have to have to be operating at once; hacker impulses are in a constant tactical struggle to avoid being constrained and co-opted, and can exist in hybridized forms along with professional and amateur forms of

cartography. As we have seen, the hacker ethic is not a unitary political stance, and thus, it may not make sense to declare that Google's Map Maker initiative is not, in its own way, a form of hacker cartography.

Conclusion

I have argued that the concept of the hacker cartography gives researchers an improved vocabulary to describe the diversity of roles on the geoweb. Through the example of OpenStreetMap I have shown that the social and political imaginaries produced in hacker cartography share strong similarities with those that are apparent within earlier computer hacker communities. The ethnographic literature on computer hackers and Free/Libre and Open Source Software (FLOSS) provides a rich source of ideas and inspiration for research into the hacker cartography, in particular the internal conflicts and contradictions within the hacker ethic. The figure of the hacker offers an escape from the bind of some analytical binaries (professional/amateur, expert/novice, and producer/consumer) while suggesting some productive yet vexing other axes, such as autonomy versus parasitism, and individualism versus collectivism. These categories suggest avenues for future research, such as: what is the role of *place* in hacker ethics, especially *vis-a-vis* emerging practices such as urban hacks, "open source urbanism" (Sassen, 2011), and civic data hackathons. Second, how might the recent resurgence of hacktivism (Taylor, 2005) (with high profile examples such as Anonymous (E. G. Coleman, 2012)) illuminate the complex online/offline political context of hacker cartography and its uneasy combination of disembodied hacker ideology with the grounded concerns inherent in creating representations of material space?

The translation of the hacker ethic into an ethic of hacker cartography also carries with it a significant caveat: while "hacker" is a label consciously self-applied by hackers themselves, the label of "hacker cartography" is an analytic construct that hackers themselves may not identify with. Thus, the observations drawn from the ethnographic research on hacker culture cannot be transplanted unchanged onto the geoweb, and must be supported by empirical research drawn specifically from sites of crowdsourced production on the geoweb. To date, such studies are few and far between (with the notable exceptions cited earlier in this article). Therefore, the concept of hacker cartography described here should be viewed as a proposal that is open to negotiation, useful as part of a framework for categorizing roles in crowdsourcing on the geoweb, but applied with care when making inferences about the subjectivity of participants in projects we as researchers might label as "hacker cartography". Further research in this area is clearly necessary.

Finally, hacker cartography stimulates more practical questions for researchers who researchers seek to apply Volunteered Geographic Information in their research, or to use the geoweb to facilitate public participation. The principles of information literacy and engaged publics professed by the hacker ethic seem like an inviting formula for creating empowered citizens. For example, researcher could

focus on designing geoweb sites with hackability in mind, encouraging unexpected uses and more actively-engaged experimentation among users. However, the analysis presented here shows many problems inherent in promoting any normative hacker identity. Hacker practice has high technical demands on users, and technological disparities (the digital divide) remain unsolved obstacles to widespread digital literacy. Fundamentally, hacker cartography is a lived practice that is still developing; therefore, the analytic concept presented here can only strive to evolve and an attempt to keep pace, while simultaneously taking a step towards a more complex understanding of the agency of VGI contributors and geoweb participants of all kinds.

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