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Introduction

Hacker and maker spaces (HMSs) are collective organizations (Ferguson, 1991; Rothschild & Whitt, 1989) that maintain workshops for individual tinkering, social learning, and group collaboration on creative and technical projects, generally among adults. They maintain policies of open-access and volunteers typically pay a small fee (typically \$25-50 per month). Over 500 HMSs currently exist worldwide (Moilanen, 2012). A scarcity of research confounds easy claims, but self-produced documents (Pettis & Schneeweisz, 2011) show that HMSs have been propelled by German hacker groups such as the Chaos Computer Club (CCC) (Maxigas, 2012), fused with American hacker (Thomas, 2002) and maker culture (Anderson, 2012).

Hacker and maker spaces arise from grassroots networks through a shared interest in maintaining a semi-permanent space for solo and collaborative work. They generally employ democratic and meritocratic conventions rather than “top-down” organizational practices. These conventions evolve over time as they are reflexively modified by members through communication (McPhee & Zaug, 2009) and practices (Cox, 2005; Wenger, 1998) in and around physical space. This loose organizational structure and plurality of participant identities results in a tremendous variety of spaces that are best thought of as having a family resemblance (Wittgenstein, 1953) of organizational conventions and shared histories rather than consistency in interests or ideology. Some are firmly entrenched in information security (infosec) while others maintain a focus on artistic endeavors involving welding and woodworking. Several have arisen with an overtly feminist orientation and push back against the often male-dominant nature of these spaces.

A growing body of literature coming from cognitive psychology, constructivism, experiential learning, and design theory explores the pedagogical benefits of hacking and making. Hacking and making are terms whose meanings vary by discipline and context, but are generally used by these scholars to refer to creative mis-use and hands-on construction, respectively. The breadth of this scholarship prevents universal conclusions, but several points should be drawn out to inform the current discussion. Scholars drawing on a constructivist line of scholarship (Papert, 1993) draw attention to the self-discovery that comes from encounters with objects (Cetina, 1997). This argument has been extended to technical learning, as free encounters with technical objects and systems are argued to encourage epistemological pluralism (Turkle & Papert, 1990). Experiential learning originates from Lewin, Piaget, and Dewey, and focuses on a continuous process of learning grounded in experiences that arise from an interplay between individual and environment (Kolb, 1984). The spatial nature of HMSs can be seen as a way to negotiate different learning styles through

constructivism (Dede, 2001) and experiential learning (Kolb & Kolb, 2005).

Matt Ratto (2011) defines “critical making” as a combination of critical thinking and material production. His contribution for the current discussion is: if critical makers can “reintegrate technical and social work and thereby innovate both” (p. 258). Design appears a fertile inroad for thinking about empowerment and politics, as particular genres of technology are created through complex social, economic, and cultural processes, leading to literacies that can be drawn on and reconfigured (Balsamo, 2011). DiSalvo's (2009) notion of critical making involves users in the design process through practices such as tracing and projection, resulting in the creation of new publics. This was later developed into “adversarial design” (DiSalvo, 2012), which confronts the politics of technologies of objects with an intent to encourage participation. Rafi Santo's (2011, 2013) “hacker literacies” similarly positions hacking as enabling critical thinking within a framework of media literacies.

Fostering open learning environments (Hannafin, Hill, Land & Lee, 2013) and project-based learning (Blumenfeld et al., 1991) appear essential for motivating the social learning and personalized involvement these scholars advocate for. For example, Beth Kolko, inspired by the hacker and maker space movement, created a semi-formal open learning environment “Hackademia” (Kolko et al., 2012) rooted in the learning partnership model (Baxter Magolda & King, 2004). She found that the workshop’s success over five years could be attributed to personal connections, topical engagement, and a sense of belongingness with other members. Anne Balsamo (2011) focused on how museums serve as physical locations for face-to-face interactions, transmission of tacit knowledge, and emergent practices with technology. Social contexts for hands-on work are also beneficial for learning through peripheral participation (Lave & Wenger, 1991; Wenger, 1998). The grassroots nature of HMSs provides a contrast to the less popular FabLabs (Gershensfeld, 2005), which operate as franchises that require expensive tools, and Computer Clubhouses (Kafai, Peppler, & Chapman, 2009), which are extensions of schools. Hacker and maker space backers such as Mitch Altman claim that hands-on interactions with technology enable a more flexible and personalized learning experience than an institutionalized curriculum (Baichtal, 2011).

Examining hacker and maker spaces promises to help illuminate how participants imagine, build, and maintain informal learning spaces (Dede, 2001; Hannafin, Hill, Land & Lee, 2013; Kolb & Kolb, 2005) “in the wild.” There is remarkable alignment between the recent work of learning scholars (Bilandzic, 2013, 2013; Ratto, 2011; Santo, 2011, 2013; Sayers, 2012) and HMSs' support of informal tinkering (Hunsinger, 2011) and peer collaboration (Moilanen, 2012; Pettis & Schneeweisz, 2011). The current study traces how members draw on hacker and maker culture to guide the learning that happens in these spaces.

Hacker Culture

Hacker culture (Taylor, 1999; Thomas, 2002) refers to one of many groups involved with free and open-source software (F/OSS) (Coleman, 2012; Kelty, 2005; Kelty, 2008), activism (Olson, 2013; Phillips, 2012), or cyber warfare (Deibert, 2013). Scholars have come to define *hacker culture* relatively narrowly to focus on a group of individuals with a common history or engagement in a shared enterprise. Semiotic disputes over hacking have also led them to use alternate terms that they feel more accurately reflect their theoretical perspective. The relationship between hacking and criminality has been much debated, and more comprehensive overviews can be found elsewhere (Coleman, 2011; Nissenbaum, 2004; Taylor, 1999; Thomas, 2002). However, generally speaking, HMSs embrace “gray area” activities such as lockpicking¹ but are not hotbeds of the most feared illegal activities that are frequent media tropes (Nissenbaum, 2004). I retain *hacker* because hackerspace members draw upon hacker culture, broadly considered, even though the sites that identify as HMSs vary widely. For example, a “hackerspace passport” created by Mitch Altman can be stamped on a hackerspace visit to indicate a connectedness to a larger global imaginary of hackerspaces.

Pragmatism, as outlined by William James (1975) and John Dewey (1938), is a branch of American philosophy that resists easy summary. It takes as fundamental the close alignment of thought with action, emphasizing the individual as agentic problem-solver who evaluates problems based on their practical applications rather than abstractions. Pragmatism has been most connected with hacker culture in critical studies’ concern with how political concerns exist behind a pragmatic front that tends to explicitly deny politics (Coleman, 2012; Maxigas, 2012; Söderberg, 2013). Gabriella Coleman observed a “political agnosticism” in free and open-source software (F/OSS) enthusiasts (Coleman, 2004). Later she elaborated on how pragmatics of working with computers and code undergird the “poetics” of hacking, both central to the “freedom” experienced by participants in F/OSS that can politicize other domains (Coleman, 2012). My interest here is less about politics, rather more about tracing where else pragmatism might lead. Söderberg (2013) notes that “not only does this pragmatic attitude enable collaborations across ideological boundaries, it also facilitates partnerships” (p. 5), echoing William James’ (1975) observation that pragmatism serves as a “method for settling metaphysical disputes that might otherwise be interminable” (p. 27). A pragmatic attitude from various iterations of

¹ The legality of owning lockpick sets is regulated at the state level, where they are generally permitted and any legal action against their owners (e.g., arrest for burglary) must show intent.

hacker culture similarly permit HMS members to construct “social laboratories or workshops that people join in order to learn and share knowledge” (Hunsinger, 2011, p. 1) even if they differ in ideology or worldview.

A related line of inquiry in cultural perspectives on hackers queries the nature of their collectivity. Geographically-disparate groups of hackers have been alternately defined as a public (Keltly, 2008), a culture (Thomas, 2002), and a collective (Bassett, 2013). The tentativeness with which scholars define hackers speaks to a reluctance to define emergent and fluid relationships a priori, overlaid with an interest in making claims across groups, particularly those connected by digital technologies such as the internet. By comparison, HMSs are collective organizations centered around maintaining a specific space. The current study's site of investigation is a single relatively bounded group (*GeekSpace*). Members are circumscribed by the built environment of the shared workshop and a shared repertoire of online communication tools (website, mailing lists, wikis).

Perhaps the largest departure from previous cultural perspectives is my viewing HMSs as an example of hacking's semiotic expansion and loosening of ties to historically closed hacker cultures. This popularization is well captured by Brian Alleyne's (2011) observation that “we are all hackers now,” a far cry from the insularity of the late 1980s (Meyer, 1989). The term *hacker* is freely applied to contexts as diverse as data-driven journalism (Lewis & Usher, 2013), urban exploration (Garrett, 2012), and creative use of IKEA products (Rosner & Bean, 2009). I frame hacking as “popular” to underscore its accessible, immediate, and participatory aspects (Jenkins, 2006), even if it is not popular in the same way as “fan cultures” (Jenkins, McPherson & Shattuc, 2002). Rather than media, the popular turn in hacking is linked to interactions with objects, platforms, and practices that invite participation and thereby increase the scope of who have typically considered themselves hackers in new and unforeseen ways. The tendency for HMSs to view themselves as open-access, although on one hand is a natural extension of hacker ethics, shifts away from viewing hackers *a priori* as subversive. This shift can be traced back at least a decade. For example, Doug Thomas (2002) concluded that “hacker culture, in shifting away from the traditional norms of subculture formation, forces us to rethink the basic relationships between parent culture and subculture” (p. 171). Similarly, such a splintering of meanings draws into question how conveniently a lineage by generations can be identified (Coleman, 2012; Taylor, 2005).

Hacker and maker space members draw on the “shared background of cultural references, values, and ideas” (Söderberg, 2013, p. 3) of a more accessible hacker culture that is social, everyday, and lived (Williams, 1995). The culture of HMSs is made visible through interactions as members draw on hacker and maker culture at large as an explanation for what it is that goes on there (Eliasoph & Lichterman, 2003; Fine, 1979). Furthermore, members self-identify

using these terms to connect with networks and refer to a shared history. The history of *GeekSpace*, for example, is easily traced directly to Germany's Chaos Computer Club (Maxigas, 2012) and emissaries from the United States who were early founders of HMSs. However, hacker and maker spaces are not synonymous with hacker culture at large. As previously discussed, since at least the mid-1990s, hackers have encompassed too wide an array of concerns and histories to safely be referred to as a unified group. Hacker and maker spaces, while a significant movement and informed by a more popular definition of “hacker,” hardly define everyone who calls themselves a hacker.

Spaces in Hacker Culture

The primary feature of HMSs is the physically-situated workshop that arises through grassroots connections. Members' need for space to socialize and collaborate isn't particularly surprising, as subcultures of all stripes require physical proximity for socializing and coming together in shared rituals (Hebdige, 1988). Online communities are often cemented by offline conviviality and mutual support (Rheingold, 1993). With scant exceptions (Coleman, 2010; Vichot, 2009), the majority of scholarship on hackers neglects the importance of space and physically-proximate encounters. For example, Gordon Meyer (1989) concluded that the computer underground was composed of isolated individuals “organized primarily on the level of colleagues” (p. 1). Paul Taylor (1999) wrote that the “immateriality of cyberspace” (p. vii) meant that hacking's “social ties are loose, even by subculture standards” (p. vii). Coleman (2010) asserts that previous literature such as Taylor's “fails to substantially address (and sometimes even barely acknowledge) is the existence and growing importance of face-to-face interactions” (p. 48). For example, Vichot (2009) notes how communities of hackers that coalesce online use “real space” to gain visibility needed to accomplish their collective political goals.

The lack of consideration of spatiality is an echo of “cyberspace” being the dominant metaphor in popular culture for going online in the 1980s and 1990s. Cyberspace is predominantly a genre of science fiction that focused on an elsewhere that was disembodied and speculative. To Taylor (1999), the ephemerality and non-materiality of cyberspace meant that hacking occurred in a different realm than the realm world, enabling different ethical configurations (p. 144). Cyberspace's interplay with virtuality and dystopian narratives are best covered elsewhere (Dodge & Kitchin, 2001; Light, 1999; Sterling, 1988), but it is simply not the right metaphor for thinking through the kind of engagements we see in hacker and maker spaces in the current day. As Eric Gordon (2007) puts it, the major shift from the 1990s to today has been from “distant cyber-worlds, fragmented communities and disembodied individuals” to “a far greater emphasis

on social connection, embodied interaction, and collaborative production” (p. 885). The internet has not negated the need for in-person collaboration or, although it has altered how we use space. Mobile, internet-connected devices in particular have enabled individuals to be constantly in movement while they are aware of being situated (de Souza e Silva & Frith, 2012) and involved with place-making practices of their own (Farman, 2012).

The deep desire of HMS members for space of their own is more than just a convenient metaphor, but a reflection of a genuine need. Temporary and more permanent spaces such as universities, *2600* meetings, and conventions have been used by hackers for decades to share information and socialize. Common lore has hacking emerging from student organizations at universities. The term *hack* is said to have originated at the Massachusetts Institute of Technology at the model railway club, where it was used to refer to a creative or innovative fix for a problem. Although it originated in a hardware context, it is most often applied to the pleasures and challenges of software production. When immersed in a late-night bout of programming, “a hacker attained a state of pure concentration” (Levy, 1984, p. 23). Predominantly male (Adam, 2003; Taylor, 2002) hackers oriented their lives around coming together in nightly rituals to solve challenging software problems (Turkle, 1985). Eventually, personal computers permitted a more informal style of programming compared to university punchcards and moved the primary site of hacking from universities to basements and bedrooms. Even everyday spaces used by hackers such as garages have been elevated to a status of the point of origin for companies (Godelier, 2007). These apocryphal origin myths now allow powerful global corporations such as Facebook, who now lays claim to terms such as *hackathon*, to negotiate their insider status while still recalling humble DIY beginnings (Fattal, 2012).

The publication *2600* has been identified as a cornerstone of hacker and phreaker (phone hacker) culture (Thomas, 2002). Its status as a publication tends to overshadow the importance of monthly meetings that were publicized in the magazine and provided an important lifeline to a local social group. At these meetings, tips were traded, faces were placed with online handles (nicknames), and socialization into the hacker culture generally commenced. The public nature of these gatherings was an advantage but also a source of frustration for “elite” members who grumbled about having to deal with “newbies.” The publicness of these meetings ensured interplay between pseudo-anonymous bulletin-board systems (BBSs), longstanding members and genuinely interested newcomers. However, they were only temporary and the often-real threat of being surveilled brought an air of danger to the proceedings. The excitement of these meetings mirrored the thrill observed in yearly conventions such as DefCon (Coleman, 2010).

Viewed as a continuum, temporary and more permanent spaces used in

passing by members of various communities for different purposes served as third places (Oldenburg, 1997), or spaces for informal gathering and bonding outside of home and work. Touchstones for hacker and maker space members emerge time and again, such as German models imported to the United States via Noisebridge and Resistor NYC (Haas, Ohlig & Weiler, 2007). However their “true” origins will likely be always be subject to debate because, in addition to a lack of documentation, these spaces are both quotidian and encourage a plurality of uses. For example, the L0pht hacker collective in Boston operated from 1992 – 2000, well before the modern period. Their location (The l0pht) served as a home for members' entrepreneurial ventures (millinery), equipment storage, and a hangout after 2600 meetings at the Prudential food court. Depending on when you happened to drop by, you might conclude that it was a raucous party spot, infosec operations center, or hat manufacturer. The L0pht did not host a single group or set of activities. Rather, it served multiple purposes for the hacker community. The permanence of HMSs similarly serves as a magnet to attract interested members, enabling and constraining the wide variety of activities that occur therein.

Materialities of Hacking

Jordan stipulates that the commonality of various perspectives on hacking (Himanen, 2001; Wark, 2004) is the hack, or the “ability to create new things, to make alterations, to produce differences” (Jordan, 2008, p. 7). These differences are linked with what Steven Levy (1984) called a “hands-on imperative” (p. 28) and enjoyment from deep concentration. By this line of thinking, the prerogative of hacking is that people should encounter technology not just to gain experience but for the enjoyment of pushing boundaries of what it was meant to do. Taylor (1999) describes the “kick” of hacking as “satisfying the technological urge of curiosity” (p. 17). This transgressing of the internal logic of systems lends a thrill that is difficult to pin down but is understood by those who have experienced it (Csikszentmihalyi, 1997).

Tim Jordan's (2008) assertion that “hacking both demands and refutes technological determinism” (p. 133) gestures at a blending of material and social agencies in specific contexts. In other words, hackers see systems as malleable even as they rely on them to accomplish goals. Jordan saw this as paradoxical perhaps because technological determinism tends to be only viewed in the negative (Peters, 2011). Viewing his statements as a reflection on enabling and constraining (Giddens, 1986) engagements with materialities, rather than “determinism” per se, brings us towards a more productive theoretical framework for thinking about the connection of HMSs to informal learning.

Materialities is a major philosophical tradition that spans behavioral,

sociological, and anthropological domains. Evolving from materialities' roots in Marxism and cultural studies, the latest wave of interest in materiality from anthropology focuses on specific domains and artifacts (Miller, 2005). Sociologists, by comparison, draw on materialities to describe the operation of larger social systems. Organizational scholars focus on how technology leads to organizational change (Leonardi, 2008; Orlikowski, 2007). For example, Leonardi's (2011) theory of imbrication, drawing on Latour, posits that individuals and technologies both have agency. Investigating the interplay between the two requires micro-interactionist investigations of everyday routines. The most prominent example of imbrication in HMSs comes from an influential presentation at the 2007 Chaos Computer Congress (CCC) where Haas, Ohlig & Weiler presented "design patterns" to create a hackerspace. This PowerPoint turned into a widely-circulated PDF describing socio-material "patterns" to bring about changes to routines for better sustainability, independence, regularity and conflict resolution (Haas, Ohlig & Weiler, 2007). Their invoking of *design patterns* recalls similar efforts in software (Gamma, Helm, Johnson & Vlissides, 1995) and architecture (Alexander, 1979) to combine social and material agencies to bring about a beneficial goal. The presenters were eager to stress that these were not blueprints, only practices that could be reflexively modified as needed. They were no determinists, but were utterly pragmatic in the sense of relying on implementation, failure, and modification to solve problems in a given system.

My invoking of materialities, such as in *design patterns*, is driven by these moves towards the particular (Miller, 2005) and thinking through the interplay of individual and material agencies (Leonardi, 2011). Materialities of hacking have predominantly been considered through software and virtual environments (Chun, 2004; Sundén, 2003). The production of differences in hacking has been generally considered to rely on the replicable nature of software that is strategically deployed to bring about change (Coleman, 2012), such as when hackers release an exploit of a security vulnerability a company refuses to acknowledge (Thomas, 2002, p. 94). As previously discussed, scholarly interest often focuses on the political significance of these acts. For example, Sauter (2013) argues that using distributed denial of service (DDOS) attacks on a website is seen by participants as an act of civil disobedience. Members of HMSs, driven by hacker and maker culture, infrastructure their own space and populate it with tools, effectively de-virtualizing materialities. Buildings and tools in HMSs are treated very much as code: malleable, changeable, and durable.

Maker Culture and DIY

The modern concept of *making* or a "DIY ethic" entails self-directed hands-on activities with flexible goals (Gauntlett, 2011; Knobel & Lankshear,

2010; Kuznetsov & Paulos, 2010). Compared with the contentious history of hacker culture, the history of making is comparatively unmapped. It can be most accurately described as a new craft movement (Rosner & Ryokai, 2009) that recalls relationships with materials through craft (Sennett, 2008) and hobbies (Gelber, 1999). Common activities among makers include assembling hardware kits, creating fabric “wearables,” and working with wood and metal. Making is nested within a complex set of attendant social and technical practices. Online resources and communication are employed for creating and retrieving schematics, plans and how-to guides. Maker culture can be seen on websites such as Instructables, in publications like MAKE Magazine, and in small businesses such as AdaFruit Industries, which supplies a range of kits and equipment. Maker faire, a series of gatherings organized by Dale Dougherty, has become a large-scale event attracting hundreds of thousands of visitors, with mini-maker faires springing up worldwide.

Maker culture has been criticized for simply being a de-politicized version of hacker culture, naively unable to reconcile its own promises of a revolution (Morozov, 2014). While maker culture’s connection with socio-economic change and hacker culture at larger is debatable, it seems more certain it comes with an attendant set of nested practices and attitudes. Lindtner and Li (2012) describe maker culture as “technological and social practices of creative play, peer production, a commitment to open source principles, and a curiosity about the inner workings of technology” (p. 18). Chris Anderson (2012) claims that the maker movement has three characteristics: the use of digital tools for creating products, cultural norms of collaboration, and design file standards (p. 21). Hughes (2012) notes maker culture’s emphasis on being open-source and posited that it “ties together physical manufacturing skills with the higher end technical skills of hardware construction and software programming” (p. 3884). For example, plans for 3D printers that create objects from extruded plastic are distributed online, but these printers are often expensive and difficult to maintain.

Making focuses on relationships with physical objects and tools, but similar to hacking, also requires social contexts for creative play. David Gauntlett (2011) defines the act of making as connecting individuals to materials, social collaboration, and global networks. He situates “creativity as social glue” (p. 217) and intriguingly proposes that “meso-level social structures could act as integrating elements between individuals and society” (p. 224). Henry Jenkins similarly noted that “do it yourself” is a diffuse notion that can be conflated to an individualistic perspective on creative and technical work, and thus he advocates for moving towards more “collective enterprises within networked publics” (Knobel & Lankshear, 2010, p. 232). Compared with hacking, making is more involved with creating objects within a lineage of craft or art. Rather than hacking's strategic to bring about *differences* (an outcome), making is more

concerned with an ongoing *process* and the satisfaction that comes from it. These distinctions, however tentative given the fluid nature of the cultures under study, are conceptually useful because they capture ways members discuss how space should be used for informal learning.

Study Context and Methodology

Participants were recruited from *GeekSpace* (an alias), a North American HMS in a city of approximately 500,000 people. Contact was initially made over email to a director to arrange a visit. The remote location presented a burden for ethnographic observation, so it was decided to continue with a set of local and remote interviews. Recruitment was conducted in-person or over email. Interviews were conducted in-person, or if that option was not available, over Skype. The 13 interviews ranged from 25 to 63 minutes in length. No compensation was offered.

Grounded theory (Glaser & Strauss, 1967) was selected for analysis due to its rich history as an interpretive approach to data analysis (Berg, 2004), appropriateness for analyzing multiple types of data, and history of use in organizational research (Martin, 1986). As previously discussed, there was little previous research bridging learning theory on hacking and cultural perspectives of hacker culture, making an emergent approach more appropriate. I was primarily interested in how members of HMSs created their space and structured the learning that happened therein. However, members' reliance on comparatively unmapped areas of hacker and maker culture, if not the deliberate evasion of traditional organizational or learning strategies, confounded the formulation of explicit hypotheses.

Interview data were subjected to evolving and cyclical interpretive analysis of participant's subjective experiences. Interviewees were asked specific questions about hacker/maker identity, structuring learning, and materialities of the space itself. This line of questioning proved useful for encouraging participants to elicit differences in their group culture over time, and the relevance of learning to their collective enterprise. The interview format also allowed for both in-depth inquiry on specific topics and the emergence of related topics important to the members. Specific emergent themes arose that cut across these categories, such as gender and projects. Interviews were transcribed and color-coded using Microsoft Word, then categorized using Excel according to the central research questions of this study.

Hybridization of Hacker and Maker Culture

GeekSpace changed their name to be a "maker" space towards the end of

the summer of 2011. This change was propelled by a move from the old space, new directorship, and loss of old members. Mark, one of the original co-founders, remembered the old space fondly, but others were less nostalgic, drawing a connection between hacker culture and a lack of projects being completed. Nancy, one of the first women members, recalled the old incarnation as “just another social club” that was composed of “hackers and not so much makers.” To her, the primary downside of the previous version of the space was the lack of productivity. Mike, the most involved director, described a conscious move towards maker culture and away from “being like a closed little nerd group that requires a prerequisite of being able to program in C.” Software production was frequently used as a point of contrast to the current space. *Making* captured a notion of productivity and openness that the previous iteration lacked. Mark described the current version of *GeekSpace* as “more of a makerspace... there's a lot of physical fabrication happening.” The original members, by comparison, were “more software [oriented]... specifically, hardcore infosec [information security],” harkening back to the group's roots in local *2600* meetings and professional occupations.

GeekSpace went through what Ann Ferguson (1991) described as a struggle for collective organizations not to become “normal” during a period of change. The slippery definition of hacker was central to these negotiations, as “the practice of the group must reflect a consciousness of the necessity to remain different, oppositional, and not to become institutionalized” (p. 114). The term hacker in 2011 bundled a resurgent popularity even as many of the negative stereotypes remained. *GeekSpace* members flirted with *professionalization*, or a movement from infrequent actions and confrontations to gaining greater permanence and recognition within a local community (Staggenborg, 1988). Indeed, increased interactions with other community organizations placed members in a tricky position of deciding when and how to employ *hacker*. During this time the group negotiated residence in unused space of a local non-profit in exchange for technical support. Somewhat paradoxically, the group took advantage of their backgrounds in software even as they were careful to denote they weren't “those kinds” of hackers. In correcting misunderstandings they both negotiated the stigma around hacking while retaining the term as central to their operations, albeit less so than before. Wayne, a director, would use the term in public because he knew people might question it. He saw this as a chance for redefinition, to get people to “realize that we're not just guys who read *2600* and try and make free long distance calls.” Nancy similarly described it as a “word we're trying to take back” from the media. Even as outwardly the organization shifted to being a *maker* space the word *hacker* continued to be a potent way they could mark the difference of their space as compared with other types of shared workshops.

GeekSpace was founded by an initial membership drawn from 2600 meetings and networks strongly linked with hacker culture (information security). After this initial period, the flavor of the collective changed as they gained new members who were unaffiliated with the initial group. Rather than fully reject notions of hacking, the term was easily appropriated by new arrivals. Hacking curiously remained useful for members to describe activities in the space even as their outward identity moved to be more of a maker space.

Doing it Together

Literature on *DIY* tends to avoid discussing how truly doing it yourself can be profoundly isolating. At worst, this places an unrealistic burden on individuals to learn through an individually-directly but vague “bootstrap” model of learning. Experiential learning, by comparison, draws our attention to the relationship between the individual and environment. The most important shift in learning during this period was members' relationship to knowledge. *GeekSpace* attempted to democratize hacking and move towards a more inclusive model. This stands in contrast to Jean Burgess' observation that hacking “as an ideal, permits rational mastery... but in reality, it is only the technical avant-garde (like computer scientists or hacker subcultures) who achieve this mastery” (Burgess, 2012, p. 30). Individualized encounters with software gave way to making and hardware tinkering where users learned by doing (Rosenberg, 1982). Collaborative work in the space took place in small groups clustered around a project, or the projects were passed from person to person to solve specific problems. The frustrations members had with the first phase of the space organically shifted to a set of practices based in materials, routines, and projects. “Collaboration on ideas and [their] physical manifestations,” in the words of a *GeekSpace* director, is “how you tell somebody's part of the community.”

GeekSpace members imagined their group as a crowdsourced meritocracy, and described themselves as a formal organization mainly to obtain non-profit (501.c3) status and insurance. They eschewed structure and desired only a minimum of organization to keep the space open and running. One *GeekSpace* member described HMSs in reflexive terms as *meta-organizations* that are simply “driven by what its members want to do.” This functionalist definition implies an “anything goes” attitude that could be taken for anarchism. Quite to the contrary, members were self-regulating and saw tools and space as providing deterministic solutions (Jordan, 2008). The materialities of the space and tools allowed them to operate a democratic-meritocratic system focused on shared work with a minimum of hierarchy or rules. This spatio-materialistic perspective echoed a hacker reliance on “rough consensus and running code” that moved projects forward (Davies, Clark, & Legare, 1992, p. 543). Discussion was frequently too

much hassle and was seen as taking time that could be spent on just doing whatever was being proposed.

A physical workshop, then, helped reconcile often highly individualistic and introverted personalities to pursue collaborative learning together. The community nature of the space meant that it was easy to drop by, and relationships often developed between members. However, *GeekSpace* was initially populated by members often in technical professions and used as a “social club” to blow off steam, play foosball, and drink. The learning that occurred there was mainly self-education and listening to the occasional guest speaker. In retrospect, members, particularly those not coming from technical backgrounds, saw the failure of this space as the lack of collaborative work in the form of projects.

Projects as the Glue

David Gauntlett's (2011) work on making suggests the existence of “meso-level social structures” that are glued by creativity. The “doing it together” instinct in HMSs may be one precipitated out around projects. Cognitive, classroom-based definitions of *project-based learning* tend to be formulaic (Blumenfeld et al., 1991). By comparison, the colloquial definition of *project* can be handily ambiguous about what is under construction. A project can be artistic, technical, or culinary (in the case of “food hacking”). It can be related to one's occupation, entirely recreational, or part of a movement from one to the other. For example, the then-director first came to the space to solve specific problems with a cell phone range booster project at a local university and the group supported him. Later he became a central figure in *GeekSpace*, enthusiastically negotiating external partnerships through projects. He promised a local group they would create a tree topper for a local Christmas fair, and the group banded together to create a tesseract (a 3D representation of a 4-dimensional cube) that would be a visible contribution of the group to the local community.

The ambiguous nature of projects, combined with their potentially long lifespan, led to new opportunities for collaboration. Projects were vital to linking personal interests to sharing and collaboration, with one member, echoing the overall pragmatism of the space, describing them as “education in disguise.” Projects could be based in hardware, such as an RFID reader attached to a mechanical assembly to replace keys for entry and exit. They were often left out in various states of assembly with the understanding that they might start a discussion or draw other members to design it better. Materiality took center stage as projects acted as an assemblage around which participation occurred.

A project-driven space was seen as necessary to drive growth and socialization over time, as related by a participant named Carl: “you have these

ad-hoc groups that form and just disband. They form again and disband. Then the individual ties between units in the group become stronger as part of this experience.” Yet, he developed a distaste for the term *project*, a term other members gravitated to, because he saw it as an artificial driver of work. To him, *tinkering* was a more genuine encounter for passion-based learning. Projects were mainly useful because “flexibility... and flitting around between interesting ideas is I think the most enriching experience in a hackerspace.” The emphasis was placed on constant process where, as Gabriella Coleman describes coding, “the lines between play, exploration, pedagogy and work are rarely rigidly drawn” (Coleman, 2012, p. 99). Carl’s reaching for an unconstrained mode of encountering objects and learning from them is clearly idealized. Yet this slippage speaks to precisely how projects, like the space itself, was paradoxically both always under construction and a yardstick of success.

When Openness Fails

An emergent concept in this study is when the inclusivity members strived for failed to attract participation by women. While this certainly isn’t the only way to consider how diversity relates to participation, it was most salient issue of inclusion among members. While gender issues have been a periodic interest in writings on hacker culture (Adam, 2003; Taylor, 2002), it is unclear what differentiates it from larger framings of women in technology more broadly. *GeekSpace* attracted dedicated female members who quickly “geeked out,” joining the directorship, but new female members didn’t feel inclined to “hang around” (Ito, 2010) for peripheral participation. To explain this we could broadly point to the constant churn of members joining and leaving and the masculinized nature of technological roles in society (Abbate, 2012; Margolis & Fisher, 2002). More specific to the lived experiences of members, female visitors simply found certain practices disconcerting. For example, in the old space, visitors needed to obtain two signatures from two members to be approved for membership. This was seen by the directorship as a small barrier to entry and by female visitors as an unnerving time to be “judged” by uncertain criteria and leadership. In other words, what the two founders saw as a “weak” culture was interpreted as a “strong” one by women visitors. Querying the power dynamics of interactions takes us further towards unpacking when a cultural style can be inhibiting of participation, particularly geeks among who may embrace alternative masculinities (Kendall, 2002; McRobbie & Garber, 1976; Wilkins, 2008).

Diversity may be difficult to address in hackerspaces because meritocracy paves over individual differences in the name of an equal chance to succeed. In other words, the reproduction of differences can be fed by an insistence that these spaces are truly egalitarian, an effect long observed by “structureless” activist

groups (Freeman, 1971). This is particularly troubling when read against HMS members' desire to often construct a participatory democracy (Ljiphart, 1999; Touraine, 1997) and enable unconstrained agency (Dewey, 1938; Giddens, 1986). Certainly, claims about hackerspaces as isolated from their socio-economic, cultural, and historical referents fall short. Hacker and maker spaces are nearly universally defined within relatively affluent western cultures, raising obvious questions of economic privilege as well as more difficult ones of how spaces are defined by various cultural imaginaries. Mirroring previous work on collective organizations, HMS members' desire for an idealized space appears driven both by their exposure to a participatory democracy (Turner, 2013) and shortcomings they see in that model. Participatory culture, as an ideal, may be a utopian goal (Jenkins & Carpentier, 2013, p. 2; Turner, 2008), imagined here through material engagement.

Discussion

Hacker and maker spaces occupy an important place in the everyday lives of HMS members' informal learning practices and fulfilled desires to tinker beyond the workplace and home. These spaces encouraged positive experience that “arouses curiosity, strengthens initiative, and sets up desires and purposes” (Dewey, 1938, p. 38). At the start of this study, *GeekSpace* presented a puzzle: “the hack” (Jordan, 2008) is linked with a critical stance by pushing boundaries of systems and technologies, and HMS members are a diverse and fickle group of participants with a distrust of institutionalization. Couldn't this group socialize as they always have, through online communication and infrequent meetings?

The motivation behind the spatial move of HMS members appears to be three-fold. First, members used space and projects to encourage interactions rather than relying on a heavy-handed organization they would find overly institutionalized. Interviewees didn't express confidence that online communication would entice participants to engage in work. Second, the personally meaningful work it attracted became a yardstick of the space's success. Third, the space acted as a recruitment tool for participants and served as a source of solidarity as members rallied around the space. This emphasis on actively inviting new members drew attention to the group's latent desire for open-access, a radical shift from the often insular nature of hacker culture.

Returning to our consideration of the semiotically flexible definition of *hacking* and the rapid proliferation of HMSs over the last five years, it seems fitting to reflect on whether these findings could reflect similar changes in other sites. *GeekSpace* is just a single HMS, rooted in North American culture, but the group had an affiliation with other groups through periodic visits and online resources such as mailing lists and IRC. Jeremy Hunsinger (2011) observed an

alignment with pragmatic problem-solving across various HMSs by examining their websites and social media (Flickr). Comparative studies, particularly involving the interplay between spaces and digital media, are needed to consider how HMSs are networked or how such patterning of spaces emerges.

Conclusions

Making's quotidian relationship with hands-on work and the materialities of hacker culture can be connected to learning theories that were our inroad. From design, a critical making perspective on material production (DiSalvo, 2012) and literacies (Santo, 2011) speaks to hacking's critical perspective being embedded within a "hands-on" imperative. The broad move away from cyberspace metaphors suggested by Gordon (2007) and serves as a vital counterpoint to why the interplay between individual experience and environment still matters (Dewey, 1938; Kolb, 1984). Experiential learning at GeekSpace was enmeshed within a desire for a "more participatory culture" (Jenkins & Carpentier, 2013, p. 266) anchored by the space. *GeekSpace's* existence, then, was based on an idealized belief in an "organization in which all individuals have an opportunity to contribute something, and in which the activities in which all participate are the chief carrier of control" (Dewey, 1938, p. 56).

Hacker and *maker* represented not so much discrete categories as fluid identities that emerged by on mode of work, personal history, and comfort with cultural alignment. This cozy relationship troubles easy stereotypes of hacking as related to scientific rationality and making to felt experience. For example, as Lingel and Regan (2014) observe, the experiences of software developers can be both highly rational and deeply embodied, resulting in their thinking about coding as process, embodiment, and community. The thrill or pleasure of hacking being linked simply to transgression or satisfaction of completing a difficult job seems lacking (Taylor, 1999; Turkle, 1984). From the side of craft, Daniella Rosner (2012) draws a historic connection to the humble bookbindery as a material-workspace collaboration and site of personalized routines and encounters with tools that lead to complex collaborations. These ethnographies take into account passions and relative definitions of technology that are often neglected in organizational studies. Thus, these inroads to informal learning could be mutually informed by Leonardi's (2011) notion of *imbrication*, where material and individual agencies are negotiated through routines over time.

HMSs are an example of how the pragmatic attitude and materialism of hacker culture can lead to new venues for collaboration. Participation in HMSs can be empowering, as participants are connected to a shared workspace and network with similarly passionate others. When paired with the space's democratic-meritocratic conventions, it's tempting to view this as a

democratization of hacking itself. This claim, however, threatens to unrealistically situate hackerspaces as paragons of learning and overly central to hacker culture at large, and democracy as a panacea. As discussed, *GeekSpace* was not without exclusion that operated in spite of its official ideology. Further, *GeekSpace* was constantly being re-built around individual conflicts, organizational collaborations, and cultural shifts. Returning to revisit the question of collectivity itself, the emphasis of the collective is on maximizing perceptions of individual agency through material and social encounters. This harkens back to Thomas' (2011) observation that "collectives provide tools for the unique and individual expression of identity within the collective itself" (p. 2) and is why "community," which works quite oppositely, is likely the wrong form of social structure at work. HMSs provide a context for a *negotiated sociality* – sometimes warm conversations, frequently simply co-working. This provides a physical example of Turkle's (1985) observation that, online, "hacker culture is a culture of loners who are never alone" (p. 196). The failure of the first incarnation of *GeekSpace* was, in the eyes of members, an abundance of socialization.

The culture of a hacker and maker space centers around openness that supports the needs of members. The benefit of these spaces is best summed up as *flexibility*. Members are supported as they join the space, become peripheral participants, and potentially, become longstanding members engaged in ongoing projects. Hacking, like art, becomes not the domain of the elite or reified objects but intimately tied with everyday experiences throughout one's life (Dewey, 1934). The pragmatic devotion of HMSs to recursive problem-solving attracts members who see HMSs bringing informal education and collaborative sociality to their city. In interviews *GeekSpace* members freely offered beliefs about why they saw HMSs as vital to reforming their city at large. Flexibility, exercised through the constant churn of hands-on work on projects, was coupled with optimism for making a better future. Kligler-Vilenchik et al. (2012) describe a similar desire in civically-minded youth organizations as a "wish to help" (para. 1.5), a form of engagement more familiar to volunteerism than hackers that exert their collective power through protest or software (Coleman, 2012; Sauters, 2013). Above all else, this optimism drives HMS members as they seek to reframe what hacking and making can accomplish.

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