Hacking the museum? Practices and power geometries at collections makerspaces in London

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Abstract

This paper examines the recent phenomenon of 'collections makerspaces', which are defined for the first time as dedicated public sites in cultural institutions with suites of creative tools aimed at inspiring new engagements with a collection through hands-on making and learning practices. Working from the notion of space as a form of power geometry (Massey 1993), its component parts woven together through an ever-evolving constellation of the overlapping histories, imaginaries and cosmopolitics of myriad actors, the paper begins with a genealogy of shared machine shops in the U.K. as viewed through four cumulative waves of innovation, with collections makerspaces located in a fourth wave that is defined by institutional affiliations. The circumstances of collections makerspace sites situated at three museums in London (Tate, the British Museum and the Wellcome Collection) are then explored through an examination of ethnographic observations of practices that are either canonical or distinctive, and the corresponding geometries of power they reveal. In conclusion, it is argued that the collections makerspace is emerging as a key site of critical institutional inquiry which carries the potential to reframe museum hegemonies through peer production practices.

Keywords

Makerspaces, institutions, hacking, museums, hegemony, power, ethnography

Introduction

"How people think about the institutions under which they live, and how they relate to the culture of their economy and society, defines whose power can be exercised and how it can be exercised." – Manuel Castells

Digital studio, innovation lab, makerspace, hackspace, fablab, incubator, Tech Shop, medialab, hardware studio, maker library, design hub – and now, a collections makerspace…?! The role of the shared machine shop as a site for situated hacking and making practices is changing, its variations becoming as myriad as the titles used to describe it. What, exactly, is a shared machine shop today? Is it an "occupied factory of peer production" (Troxler & maxigas 2014), an embodiment of the myriad dreams and contradictions of neo-Marxism? Is it an exclusive sanctuary for tinkerers and craftsmen, a place to test out fabrication equipment while harnessing historical ways-of-making? Is it a public community centre that provides tools and machines intended to help people

create things together? Or is it an incubator for transformative new models of digital participation in 'high' culture? The answers, it turns out, are as varied as the questions.

What current accounts do agree on is the fact that shared machine shops are evolving in form. There are enthusiastic visions of a digital fabrication uprising, of widespread cultural transformations enabled by peer production practices [1], of a future where anyone can make anything (Gershenfeld 2012; Fleischmann et al 2016). There are cautiously hopeful depictions of the ways that sites can foster niches of lab-style experimentation, enabling the possibilities for groundbreaking sustainable innovations that can bring about deeper societal shifts in relations of power, capital and locally distributed production (Dickel et al 2014; Smith et al 2013). There are new kinds of sites being founded with feminist, intersectional and anti-colonialist needs in mind for users who do not identify with dominant hacker archetypes (c.f. Toupin 2014). Meanwhile, an increasing number of SMSs are emerging not from the grassroots but instead through cross-sectoral partnerships between communities, companies, institutions and governments. Examples range from the Inspiration Lab, a small site for digital creativity installed in Canada's Vancouver Public Library in 2015 with the support of the municipal council, to the global fablab network, which began as a collaboration between the Grassroots Invention Group and the Center for Bits and Atoms at the Massachusetts Institute of Technology's (MIT)'s medialab in 2001. Aimed at exploring local possibilities for community grassroots fabrication, the model spread to other regions who opened sites with the same suite of fabrication and design tools. As of 2017, thousands of fablabs are listed in 30 countries on fablabs.io, many in partnership with local actors such as India's National Innovation Foundation in Gujarat (Fab City Research Lab).

Even more recently, a new generation of SMSs have started opening their doors within the walls of cultural institutions in an attempt to bring in new sources of funding along with new audiences. In London, census data continues to suggest that while visits to museums and galleries are increasing, there remains a strong causal correlation between sustained public participation in 'high' or fine art culture and socioeconomic status (Department for Culture, Media & Sport 2016, 2017; Trust for London 2015). At the same time, a blurring of boundaries between popular and fine art cultures, combined with neoliberal austerity measures across the U.K., has led to increasingly commodified settings for museums, who now must compete with shopping malls, movie theatres and other consumptive entertainments to entice visitors (Prior 2005). To address these concerns, since the 1970s institutions like Tate have tested out new museology-style [2] experiments which implement 'free learning' [3] and other hands-on pedagogies for engagement. They have also increasingly been drawn to the digital innovations of net art and other critical movements, building on a more general orientation towards participatory and relational aesthetic [4] approaches which attempt to reorient the traditional oppressions of the relationship between artists and audiences (Bishop 2012; Bourriard 2002). Experiments have taken various forms, from commissioned hacks of official museum websites, to robots remote-controlled by visitors to roam exhibits at midnight, to the phenomenon explored by this paper: 'collections makerspaces', or dedicated public sites with creative tools [5] and facilitators aimed at enabling novel engagements with a cultural collection through hands-on making and learning practices.

Some argue the critical potentials of once-autonomous shared machine shops are being diluted by the contradictions of partnership models. Initiatives like Living Labs [6], for example, have been criticized for presenting themselves as alternative, horizontal and user-centered while reinforcing neoliberal and technocratic models of urban governance that still serve the interests of capital (Cardullo et al 2017; March & Ribera-Fumaz 2016). The makerspace brand has been derided for allowing the U.S. military to play a key role in its financing (Söderberg & Delfanti 2015), and collaborations between sites and technology corporations through co-sponsored hackathons [7] and other events have been shown to produce not only prototypes but also entrepreneurial subjects, united by a shared belief that technological innovation will lead to material abundances which increase "the size of the economic pie [for a few] as an alternative to redistributing it" (Irani 2015: 802). Tensions between partners in controlling representation and practices have been noted in collaborations between grassroots innovation movements and mainstream institutions (Fessoli et al 2014) and in conflicts between open and closed worldviews within digital innovation and fabrication networks in the Global South (Zindy & Heeks 2017). While similar tensions have been recorded at library-based SMSs (c.f. Sheridan et al 2014; Slatter & Howard 2013), there remains a lack of qualitative research which examines museum-based sites, especially from a U.K perspective.

This paper explores the circumstances of three collections makerspaces at museums in London, and their relationality to other kinds of SMSs in the U.K., by examining their practices and the geometries of power they reveal. Are collections makerspaces merely stewards of the donors and corporations who brought them into being, shaped by a late-capitalist experience economy where sovereignty is abandoned in pursuit of much-needed funding – or is the reality more complicated? The analysis unfolds as follows. First, conceptual inspiration for the intersection of spaces and practices is discussed through key theoretical approaches that explore the effects of institutionalization and of space as power geometry. This is followed by a brief genealogy of shared machine shops, which I argue can be viewed through four temporal waves of innovation in the U.K., with collections makerspaces emerging as part of a 'fourth wave'. This claim is explored through an examination of ethnographic data gathered during interactions with collections makerspaces at Tate, the British Museum and the Wellcome Collection where I served as researcher-in-residence. Findings are organized according to canonical and distinctive practices observed, and their effects on spatial power geometries between sites, host institutions and funders. In conclusion, I suggest the collections makerspace can be viewed as an experimental – and potentially radical – field site for critical institutional inquiry, where museum imaginaries and hegemonies are being gradually reframed through tactical deployments of peer production practices.

The makerspace in the institution: Space as power geometry

This paper situates itself around the notion that spatiality is a constantly evolving process, woven together through multiple articulations of social experiences, histories and relations coming together in "a situation of co-presence" (Massey 1993: 64). In line

with the theoretical frameworks of thinkers like Lefebvre (1991) Massey (2005; 1993), Soja (1996) and Graham (2006) who have written extensively about the fluid and ever-shifting power-geometries of the spatial, I argue that a space [8] (from a public park to a neighbourhood to a collections makerspace) need not be defined only by its 'planners' (those who envisioned and built it) but also by the practices of its 'users' (those who work, make and hack within it). Even the most hegemonic of spaces is in fact a contested and mediated collaboration, its digital and physical imaginaries continually in the process of being reframed through the myriad discursivities, practices and routines of diverse actors. These actors may be humans (e.g. families) or non-humans (e.g. machines), and as actor-network theorists like Haraway (1991) and Latour (2005) and practice theorists like Savigny et al (2001) have pointed out, there is an increased need for social science and STS [9] approaches that integrate non-human actors as mediators, nodes and collaborators into the actor-network milieus of social processes and their corresponding shared practices. Here, the shared machine shop emerges as a distinct environment that carries its own form of "cosmopolitics" (Latour 2004 via Stengers 1997), overlapping cosmos (worlds) woven together through evolving human and non-human alliances. It is also a potential space for contestations of power relations to occur through the processes of cultural hegemony (Gramsci 1971), where a ruling group attempts to maintain its domination through cultural discourses and symbols. Such discourses can be unpredictable, however, allowing counterhegemonic alternatives to arise in unexpected ways. In such moments of fluidity, even the most seemingly dominated of spaces can also become sites of subaltern resistance.

These critical perspectives suggest there is a distinct potential for the practices of collections makerspaces and other institutionalized shared machine shops to challenge the traditional roles played by their hosts. This is no easy task, however. The discourses of hegemony employed by U.K museums, and their myriad interconnections with British imperialism and colonialism, have been well documented (Delbourgo 2017; Harwood 2013; Fuller 2008; Hall 2005). Historians like Barringer (2006), for example, have traced geographical distributions of the acquisition of museum artifacts in the 1800s to parallel distributions of imperial capital and influence. Meanwhile, governmental efforts to harness the power of public institutions in the Victorian era included attempts to pacify and educate the rowdy working classes by inviting them into the museum for 'civilising', a form of societal self-regulation reinforced by the presence of well-behaved upper-class patrons (Hall 2005; Bennett 1990). Bennett (1990) and Bourdieu (1984) have described how the duality of the public museum as a site of order and the public fair as a site of disorder in this period laid the groundwork for the ways aesthetics and cultural capital continue to be employed as key symbols of economic superiority. As Harwood stated in 2003, "The museum became, and is still, a technical solution to the problem of displaying wealth and power without the attendant risks of social disorder" (377). These institutional discursivities have been similarly portrayed by Foucault and Miskowiec (1986) and also by Bishop (2012), who have written about museums as 'heterotopias', sites of infinitely accumulating prestige made every more powerful through their educative roles as masters of public knowledge and order.

By returning to the potentials for permeability in even the most historically entrenched spaces, however, even heterotopias can be seen as “articulated moments” (Massey 1993: 65) of networked relations that are contested and reworked through the introduction of new discourses. These contestations are especially present in blended sites like collections makerspaces, which are inspired by grassroots practices but also heavily influenced by the internal priorities of their host institutions. Garud et al (2007) describe institutionalization as the process by which a group of collaborating actors leverage resources to transform an existing institution or create a new one – and in the case of institutionally-hosted spaces, building consensus between opposing discourses becomes just as important as between those of other kinds of actors. Research has found, for example, that institutions tend to become more similar over time as a result of their interrelations (isomorphism, via DiMaggio & Powell 1983), and also that despite the hegemonic nature of their systemization, businesses and corporations are deeply affected by their encounters with informal grassroots groups (Fressoli et al 2014). As Seitanidi and Ryan (2007) have found, in partnership relationships of these kinds where both parties are actively, not passively, involved, corporate community involvement or CCI can also become a process of co-evolution. This paper therefore approaches the institutionalization of shared machine shops as a process that carries the potential for transformative dynamism, constructed through social, cultural and political relations.

A brief shared machine shop genealogy in four cumulative waves, from hacklabs to collections makerspaces

In order to build an understanding of where collections makerspaces sit within the shared machine shop canon, this paper starts with a condensed genealogy of that legacy in four cumulative – and at times concurrent – waves. These waves focus in particular on moments of transformation, in the tradition of Jordan (2016), maxigas (2012), Edgerton (2011) and Smith et al (2016), who have called for critical re-buildings of historical technoscience narratives through examinations of their multiplicities and their absences. The birth of the shared machine shop occurred around the same time that the ‘hacker’ archetype itself emerged in the 1960s, taking form in the shared voluntary labours of collectivist yet amorphous groups of computer users who enjoyed exploring the limits of emergent technologies at labs at the Massachusetts Institute of Technology and other informal gatherings (Kelty 2008; Coleman 2013). These practices were similar to the ‘jugaad’ frugal engineering hacks that had already been employed collaboratively throughout the Global South for many years (Ray Murray & Hand 2014; Braybrooke & Jordan 2017), but with a new motivation which originated not from the necessity of limited technical resources, but instead from the leisure power associated with having a surplus of them. By the late 1970s, while the human tendency to engage in technological innovation was also nothing new [10], the distribution of the first consumer-ready home computers allowed the possibilities for collaborative experiments to hit a new threshold. These developments also allowed artists and tactical media practitioners to explore hacking as a creative and critical practice, resulting in seminal works such as Roy Ascott’s ‘Terminal Art’ (1980), a telematic art network built before the advent of a public world wide web that linked together a group of artists across California, New York and Wales using an early computer conferencing system [11].

The clearest physical manifestation of the hacker subculture also emerged in the 1970s – the shared machine shop (SMS), or an innovative laboratory for experimentation and learning with open co-creation methods using digital tools (Dickel et al 2014). The idea of gathering spaces for hackers and machines to meet was not exactly 'new' at this time either; it could be traced, for example, to the 'invention factories' of the late 1800s, when a research lab was first built by the inventor Thomas Edison to promote technological innovation and scientific co-creation, inspiring 350 similar sites at research institutes across the United States from 1900-1940 (Holman 2015). In museums, meanwhile, 'wet rooms' had long been set aside for conservators to isolate noxious fumes and use new technologies to work with artefacts. The British Museum in London once housed its spaces for conservators in the same basements it used to preserve some of its artefacts during WWII air raids; in 2015, it launched the World Conservation and Exhibition Centre, marking the first time in its history that conservation staff were able to work with artifacts in natural light. However, the dissemination of the shared machine shop as a public space for peer learning and digital fabrication – not only amongst professionals, but also for amateurs who just wanted to experiment – was something new.

Like the traditions of hacking, this paper argues the unique subjectivities of the shared machine shop and its manifestation of peer production practices in action can be understood from a U.K.-based perspective through four distinct waves of innovation, from radical beginnings in the 1970s (Smith 2014) to divergent iterations by the 2000s (Culpepper 2016, Dickel et al 2014; Sampsa et al 2014). The *first wave* of SMS innovation can be traced to 1970s London, where the United Kingdom's first SMS sites emerged under distinctly utopian and egalitarian circumstances. In 1976, industrial workers at the Lucas Aerospace corporation united with local labour networks, factories and socialist co-ops to build Community Technology Networks across London, sites that would test technologies relevant for 'socially useful production' over private profit, with innovations ranging from children's play equipment to small-scale wind turbines to disability devices (Smith 2014). The first hacklabs and medialabs that opened across Europe in the 1990s employed similar tactics, building solutions to local issues through autonomous, peer-produced physical fabrication – and, in the case of the medialab, new possibilities for a creative, radical, collaborative internet. A mixture of artist studio, hackspace and Californian 'cybercafe', famous medialabs like Artec and Backspc (both based in London) helped inspire a new generation of practitioners to explore the implications of computer networks (Frost 2012; Bassett 1999.) High-profile pieces included the Tate's first net art [12] commission in 2000 entitled 'Uncomfortable Proximity', a critical hack by Graham Harwood of the artists' collective Mongrel which lead web users to an alternate mirrored version [13] of the Tate website that revealed its "cultural cosmetic surger[ies]" or self-censorship of less flattering legacies (Harwood 2003: 375).

Second-wave SMSs also started to open around this period and were typically referred to as hackspaces, preferring closed memberships to provide a safe space for those who 'just loved to hack' (Levy 1986). The goal of second-wave sites – many of which still exist today like Berlin's c-base, founded in 1995 – has often been long-term community

salience over overt politicization, a fostering of greater public legitimacy for hacker subcultures in light of crackdowns on illegal activities during the mid 2000s (Farr 2009). The *third wave* of the SMS lineage can be defined as related to the period when hacker subcultures became a mainstreamed movement of those increasingly intrigued by the digital, with makerspaces, fab labs and open workshops opening around the world. 2008 has been cited as a key year in SMS history, when a widely-publicised exchange between German hackerspaces and American activists called 'hackers on a plane' brought these sites to the attention of various publics for the first time (Smith et al 2016). It can also be defined as the moment where the practices of 'openness' – that is, the free and agile sharing of ideas, templates, code and designs; the development of tools and systems for locally-distributed fabrication; the emergence of free culture and open knowledge movements around visions for a democratic, user-led commons – truly came into maturity as alternative systems of socio-economic production for shared machine shop communities (Jordan 2016; Benkler and Nissenbaum 2006; Benkler 2002).

The makerspace model, an open workshop with mentors and tools aimed at helping people learn how to make things, is a third-wave SMS variant that has been especially successful, with over 100 sites opened in the U.K. alone (Nesta 2015). Sites employ the term 'maker culture' to democratise shared machine shop traditions while drawing in users interested in creative activities not traditionally found in hackspaces, such as crafting or e-textiles (Meehan et al 2014; Davies 2017). The mainstreaming of maker symbols – such as O'Reilly's widely-read *Make* magazine and its makerfaires, where crowds of 100,000 gather in science fair settings to share projects (400 have been organized since 2012; the White House held its first in 2014) – have inspired a generation of enthusiastic digital fabrication converts, with some dubbing it a 'revolution' (Anderson 2012; Hill 2015). This claim rings a bit hollow in the face of current realities, however, with many sites remaining niche playgrounds for the already-empowered, alienating less privileged users and dependent on core elements of the capitalist economy, from open markets to global supply chains (Davies 2017; Toupin 2014; Carstensen 2013; Fleischmann et al 2016; Grenzfurthner & Schneider 2009).

Meanwhile, since 2015 a SMS *fourth wave* has started to emerge which can be characterized through its diversification as hundreds of new SMS flavours are witnessed, from makerspaces in universities to mobile fab lab-library hybrids that cross interstitial lands to access users in rural regions (Culpepper 2016; Moorefield-Lang 2015). There are plans for a 'Flotante' fablab, its modules designed by fablabs around the world, which will float along the Amazon River to "better understand the green lung of the world" (UABureau 2016). Sites are opening in neglected urban districts of cities like Buenos Aires and Detroit once known only for their post-industrial decline, such as medialab and art centre Hangar, which sits in a former textile factory in Barcelona's El Poblenou district alongside radical citizen-led cooperatives (Braybrooke 2016). This wave is also defined by an increased institutionalization of SMS practices, with sites like collections makerspaces opening through partnerships between donors, technology brands and cultural institutions, many of whom had already been testing out digital innovations since 1994, when the Natural History Museum became the first cultural institution in the U.K. to publish a public website on the world wide web (Hawkey 2004).

Early reports have lauded the democratizing potentials of museum-based sites for digital making and learning (British Council 2016; Oates 2015). However, empirical evidence remains scarce, outside of few early efforts in the U.S. such as a 2016 survey which found sites affecting the functions of institutions themselves, from new uses of 'wet', messy materials to the introduction of new staff roles (Brahms & Crowley). This research echoes similar efforts in other sectors like that of Chesbrough et al (2016), who found that the open innovation processes of R&D teams had filtered into business practices themselves, in a gradual move from closed to open models. Despite this, an alliance between community, grassroots and institutional actors can be fragile, marked by contrasting priorities (such as entrepreneurship and business skills) to those of more autonomous models. As Smith et al note, "tooling-up" does not necessarily lead to social change, especially when external funder becomes prominent (2016: 104). What, then, is the situated nature of a collections makerspace within the auspices of a large cultural institution? How does it differ from the circumstances of other fourth-wave sites?

Research data and methodology

Addressing current gaps in knowledge by focusing on the practices of U.K-based sites was a primary concern for the project examined by this paper. When the study began in 2015, 34% of sites classified as makerspaces in the U.K. had been founded with a company or organisation, compared to 47% by informal grassroots groups (Nesta 2015). Only a handful of these co-founded sites were located inside an institution like a school or library, and even less inside cultural institutions. Because four such sites were located in London (Tate, the British Museum, the Wellcome Collection, and the V&A, whose digital learning space, the Sackler Centre, was under renovation at the time of the study), the decision was made to base research there. My own interactions with sites began at the Tate Digital Studio, which I first engaged with from 2013-14 while working as design curation lead for the Mozilla Foundation. Together, we built a digital curriculum pack called "Cultural Heritage Remixjam" which introduced open access and co-creation principles to educators in a museum setting, and this is where I first saw peer production practices employed within an institution. These encounters inspired the research on collections makerspace practices later conducted at the Tate, the British Museum and the Wellcome Collection from 2016-2017, which this paper focuses on.

The Taylor Digital Studio (TDS) is a creative space for digital learning and making at the Tate Britain, one of London's oldest museums, built in 1897 when industrialist Henry Tate offered his collection of British art along with a £80,000 seed donation (Tate 2017). TDS opened its doors in 2013 as part of Millibank Project renovations, becoming a home for transdisciplinary digital programmes that combined art and technology. The Samsung Digital Discovery Centre (SDDC) is in the basement of the British Museum, the first national public museum in the world founded in 1753 (also as a result of a wealthy benefactor offering his collection to the state; this time it was the physician Sir Hans Sloane). The SDDC opened in 2009 through an agreement with Samsung Electronics to build digital learning experiences for young people aged 3 to 19. The most ambitious site of this study, its activities are carefully programmed and engage

over 10,000 visitors a year. It is also responsible for the British Museum becoming one of the world's first cultural institutions to use virtual reality technologies to engage users in its collections through a Bronze Age tour (British Museum 2017; Rae & Edwards 2016). The Wellcome Collection, meanwhile, opened in 1932 and is now the second-richest charitable foundation in the world (Dunjerski 2000), based around a vast public collection focused on the study of medical histories. Its benefactor Sir Henry Wellcome always envisaged bringing a museum, library and gathering space together, but it was not until extensive re-designs in 2014 to meet future visitor demands that the Reading Room (RR) re-emerged as a radical public venue for hands-on exploration (Wellcome Trust 2012). While it is the most "pre-tech" of the sites in this study, there are echoes of makerspaces everywhere in its myriad invitations from facilitators (c.f. Vigour 2016) to co-create and build through learning, making, rummaging and discussing. As part of their public mandates, the sessions and events of all three sites are offered for free.

In employing a multi-site ethnography as the primary method of research, this project was inspired by research that was distributed, iterative and based on collaborations with site users, allowing for immersive engagement instead of distance, a gradual "deferral to subjects' modes of knowing" (Holmes & Marcus 2008: 82; Atkinson et al 2001). In addition to working with primary sites, the research was also enriched by informal interactions, from tours to workshops, at other kinds of fourth-wave SMSs associated with institutions, from innovation hubs to privately-funded cultural bodies. These ranged from iHub's 'Gearbox' open hardware hackspace in Nairobi, Kenya to 'Hangar.org', a medialab and cultural centre opened in 1997 by the Association of Visual Artists of Catalonia in Barcelona. Meanwhile, acting as researcher-in-residence at the primary sites allowed for many moments of casual experimentation through hands-on making and hacking alongside site users, in a setting of co-present collocation (Trainer et al 2016). This included 150 unstructured hours of hanging out and making; participant observation of 20 workshops and public gatherings; action research [14] in the form of digital archive websites and workshops built in partnership with sites; 45 recorded individual and group interviews with site staff (managers, A/V teams, curators, facilitators) and collaborators (external artists, practitioners); and 50 questionnaires with site users (youth learners, adult learners, families) [15]. Interviews, questionnaires and participant observation notes were then coded, queried and organized manually into a set of thematic nodes using the qualitative analysis software NVivo. It was through this process that I started to understand that a core theme uniting user practices across sites was their similarity to – and also their distinctiveness from – the practices of other fourth-wave shared machine shops. The next section of this paper analyses the data with regards to these guiding themes, while reflecting on the ways that the deployment of making and learning practices correspond to spatial politics and flows of power.

Analysis: Collections makerspaces, practices and power

An example of the kinds of activities typically observed at collections makerspaces was "Future Makers: Clay", a two-part weekend workshop in the spring of 2017 which I built the curriculum for in collaboration with site managers at the Samsung Digital Discovery Centre for the families-focused Innovation Lab/ Future Makers series. Inspired by

science fiction and speculative design, participants were asked to analyse the British Museum's collection of Korean pottery as if they were aliens from parallel universes who were beholding Earth-made artifacts for the first time. The session started with a brief presentation of the seven Earth-like planets that had recently been identified in the Trappist-1 galaxy, followed by a tour of the British Museum's Korean pottery exhibit, where photos and notes were taken on tablets (provided by Samsung). The group then returned to the SDDC to share their galaxy's versions of pottery with Earthlings. Bringing together a diverse array of crafting materials, from model clay to fabrics to ornamental gemstones, families created their own ceramic artifact. Free glitching apps and design tools were then employed on tablets and mobile phones to 'remix' physical artifacts into digital renderings. The resulting images were projected onto a wall, with participants building a dynamic visual mosaic by adding their own physical and digital creations and then connecting them to others' works using thread and other materials. The result was a colourful, mixed media alien artwork that had been co-designed by all.

Practices canonical to those of other fourth-wave SMSs

Many of the practices observed at collections makerspaces were historically similar to typical making or hacking activities found at other fourth-wave SMSs. For example, all three sites put a primary emphasis on enabling users to co-create and learn in groups. Site facilitators often acted more like peers than conductors, avoiding traditional presentation styles where possible and ensuring furniture, equipment and environments helped build the atmosphere of a "trying-out space" in the words of a TDS manager. Sites were proud of their "inherent dynamism" (Massey 1994, p. 2) as compared to that of the external institutional environment, displaying a non-hierarchical modularity in their workshops and actions aimed at empowering users to also act flexibly. "I think," mused a RR site manager, "watching how people use this space in different moments is fascinating, because it's not a space with overt rules. So sometimes when people come over the threshold, it takes them a while to figure out what they *can* do in the space and what they *want* to do… [the room] is designed to be… egalitarian, there's not the expert, there's not the audience. No one is going to tell you what to do." A TDS manager explained how he felt digital innovation had "always been all about open source, accessible versions of high-end software emerging… this kind of sharing is how so many great things have been made. And that's a big part of the Studio. Reminding us to create new things *together*, instead of being all fancy about it." In user feedback from sessions at all three sites, phrases like "I enjoyed making things with the group / working together was fun / I didn't expect to do this in a team" was common in answer to the question "how did this space feel to you", connoting that for many users (especially those new to the site), spatial engagement also meant spatial interaction.

Building and sustaining a sense of a community amongst site users, despite the limitations of doing so inside an institution traditionally focused more on patrons who donated funds and international visitors who only engaged sporadically, was another core priority for all three sites, much as it has been for other fourth-wave SMSs. As a TDS manager described, the Digital Studio from the very beginning insisted on loads of collaboration […] bridging between teams […] because we had to bring so many

facilitators, artists, technologists, curators, producers together to do any of it." Another TDS manager noted that while her aim had always been to invite a diverse subset of users into the space, in her background in education she had learned the hard way that it would not be enough to "just open the doors and expect the community to come to you." Relationships – and trust – had to be built manually with local organisations and schools, "so we started by setting up as many collaborations as we could. And it's taken a while. It's been slow." SDDC facilitators were also thoughtful in their analysis of user demographics. As one explained in a group discussion: "We do see that while about 70% of visitors to the British Museum are foreigners or tourists, this is not the same for the Samsung Centre… it is much more local, people come over and over, or they heard about it through their schools." The majority of site users also spoke English as a first language, unlike many of those who typically visited the museum's galleries above the SDDC. Staff wondered whether it was the digitality of the room that kept them away, its basement location, or the lack of promotional materials for the SDDC being provided in other languages. "This is really above my pay grade," a facilitator reflected, "but I think the families who come into this room come into museums a lot already… so, who isn't confident to come in yet? I feel like we still need more data on that."

Indeed, while the SDDC's weekday sessions catered to a wide variety of schools across the U.K., many of the parents I spoke with at the site's weekend workshops, echoing similar demographics observed at other kinds of shared machine shops (Nesta 2015), already felt it was valuable to engage with sites of this kind in general. When asked to compare the SDDC to other hands-on learning sites of its kind, almost all of them responded with another site they had been to in London. None said it was their first time at a museum, or that they had travelled from a location outside of the city, except for one family who were visiting from New York. One woman said she and her children spent every weekend rotating between free activities at the V&A and other museums. "I want them to take advantage of the culture here," she said. "Plus, they just love it." SDDC staff were quite proud, therefore, about the launch of a new initiative to engage lesser-served families by providing roaming hands-on digital activities in the main galleries of the British Museum upstairs, in order to draw in new participants who might not enter the SDDC otherwise. At the RR, by far the most publicly-oriented and busy of the sites, a group of facilitators undertook an extensive ethnographic research project in collaboration with external academics when the site opened in order to build a better understanding of user behaviours and needs. From this they built a framework to enable those who looked hesitant to learn and play, "invigilating more participation by staying out of the way, feeling it out" in the words of a site manager. This enabled an informal environment which gave users the freedom to explore, touch and look before settling.

As was the case for many of the other fourth-wave SMSs I spoke to who had opened in partnership with institutions, maintaining equilibrium in funder-site relationships was a key consideration for collections makerspace staff. Due to cultural funds disappearing across the U.K. as a result of increased austerity measures, a trip through the British Museum is a trip through a history of corporate transactions, with names like 'Air Korea' and 'Goldman Sachs' listed aside exhibition titles. The SDDC, for example, was both named and built in the image of its donor, its white cupboards filled with Samsung-only

kit. Staff and user opinions on this matter were largely ambivalent; they were aware the site would not have been possible without such a friendship, and expressed gratitude for having been able to engage so many young learners through the project. After all, sponsorship at institutions like the British Museum also means power – for staff, the mandate to deliver experimental programmes; for funders, the prestige associated with being a part of the arts by association. As a non-governmental public body, the British Museum in particular seeks out a great deal of external support for its research and exhibitions. Under a new Corporate Membership scheme launched in 2014, sponsoring companies were offered a variety of additional privileges, from special "behind the scenes access and invitations" to exclusive opportunities to "entertain clients and staff in galleries" outside of public access hours (British Museum 2014).

One of the most infamous cases of institution-funder relations has been that of the multinational oil and gas company BP (formerly British Petroleum), which regularly donates large sums of money to cultural institutions across the U.K., from the Royal Opera House to the British Museum. In the late 2000s, its sponsorship of the Tate was thrust into the public spotlight due to its negative human rights and environmental reputation after events like the 2012 Gulf oil spill. Platform, Liberate Tate and other protest groups (their activities unhindered by Tate security and other staff, themselves in conflict regarding the relationship) held a series of high-profile occupations of the Tate Modern, which included a 25 hour stint of writing anti-BP messages on the floor of the Tate's Turbine Hall, tattooing CO2 concentrations in the surrounding atmosphere on activists' skin, and pushing through a freedom of information tribunal that exposed BP's sponsorship amounts to its recipient institutions, accusing BP of "using its donations to buy 'cultural power'" (BBC 2015). In 2017, BP ended its 26-year relationship with the Tate, citing only an "extremely challenging business environment" (Khomami 2016). Staff and users across all three sites discussed the opaque nature of these kinds of relationships, a sense that what was deemed possible when it came to digital innovation was often based on the whims of those in ascendancy. As a BM facilitator reflected in a group chat: "In the end, it really does all come down to funding, and power, who has it, what they use it for... unless there's specific funding for digital, a museum this big is not going to prioritise that when they have so many other concerns." Staff and external collaborators across all sites nevertheless expressed the belief that inside their spaces, the motivation had always been to ensure site users themselves had the most power – to reframe their engagements with collections, and even to reframe the museum.

Practices distinct from those of other fourth-wave SMSs

Other practices and interactions observed appeared to originate from the unique spatial geographies of the collections makerspace, situating it squarely within its environment. The emphasis on good facilitation over the latest technologies, for example, was often stressed by both staff and collaborators. Despite being the most visibly 'high-tech' of all sites, SDDC facilitators felt that the "careful framing of an activity" always trumped the introduction of fancy tools. Relying on the use of new technologies "to the exclusion of old or existing technologies", they asserted, would be foolish. The TDS took a similar approach. "A very interesting bit of learning I had here," a collaborator reflected, "was

that you can do deep learning about digital culture with very few tools – it's the concepts and the exchanges – not the computers – that matter." As a space fully dedicated to youth-focused digital learning workshops, the majority of which needed to be booked in advance, the SDDC was especially thoughtful about its employment of the digital, aiming for "clever" integrations that aligned with the U.K. national schools curriculum. Sites also cited the influence of constructivist [16] and hands-on pedagogies for peer-led learning. "Working in e-learning in the 1990s," a TDS collaborator explained, "I really started to understand how teaching approaches are always socially constructed. Hands-on learning… is the most emotionally satisfying, and useful." RR staff described their motivation to "hack" typical power relationships through Open Platform, a user-led series where anyone could come and hold a workshop or conversation about the RR collections. Indeed, it was during these sessions randomly run on a variety of topics, from artist discussions on dyslexia and creativity to conversations about health and resilience while stitching personal well-being postcards, that the RR really came alive.

The use of remix as a primary method for interacting with museum collections is another legacy that remains distinctive to the collections makerspace and its unique institutional affordances. From an analysis of archival data [17] from over 50 events since the TDS opened in 2006, ranging from drop-in meme-making workshops to digital artist 'show-and-tells' where external practitioners explained their practice and lead hands-on making activities, it was found that 80% of events had employed remix practices to engage with Tate collections. Site facilitators explained almost all of their young peoples' programmes made some use of the collection. "When teens get to choose classical art images and then remix, repurpose, recombine them," an artist collaborator explained, "now that's a very powerful way to change ideas about museums." Another external practitioner who had lead art workshops in the space described her motivation: "We are so alienated from our own culture. That's really interesting but also problematic, and we need to take it back. We need to appropriate it now, not defy it… rebuilding the elements… we think are worth re-creating together." The rich variety of interesting out-of-copyright works available at Tate Britain made its remix-focused sessions especially popular for younger users who regularly engaged with the TDS. At the RR, meanwhile, a manager explained her favourite artifact in the site's collection was a reproduction of the Ripley Scroll from the 1600s. For many years, she said, it had sat alone in the Rare Materials Room due to its fragility and value. But when the RR opened, a reproduction of it was made openly available for people to see, touch, and work with. "It's an amazing moment in our time," she said, "where that kind of thing can be allowed."

Enabling possibilities for youth leadership was another core method employed by sites to reconfigure the traditional hierarchies and elitisms of museum power geometries. Tate Collectives is a leadership programme for young people aged 13-25 who curate events for other young people at the Tate. The TDS has been a primary site for Tate Collectives planning sessions and events. "I remember one of the first youth meetings I'd ever been at," reflected a user who had started volunteering at the Tate as a teen. "There were Jaffa cakes, they were trying to get young people interested, but it just wasn't really possible because we were in a really boring board room. It felt so power heavy. Like being at a business! How can we get young people from disadvantaged

backgrounds involved in a place like that? So we needed a room to make them feel more comfortable… and this space came at the perfect time for that, because they really do feel like it is theirs." The SDDC also put an emphasis on finding ways for young people to engage their parents in co-creation during family sessions. In the "Digital Makers: Clay" workshop outlined earlier in this section, the parents started by making it clear to us that in joining a free digital making activity for families, they had not intended to participate themselves. Instead of picking up the Samsung devices on the tables, most began by disengaging from the session entirely, staring intently at their phones – until a facilitator came over to ask them if they would like to make an artifact alongside their children. After a moment of surprise, most parents rose to the challenge.

The last characteristic distinctive to the experience of the collections makerspace, distinguishing its environment from that of other fourth-wave SMSs, was the intricate complexity of the relationship each site had with its mother institution. Unlike a similar partnership at a SMS within an academic institution, for example, where the SMS essentially acts as a hands-on extension of the school's educational mission (for more on this, see Culpepper 2016), collections makerspaces were viewed by site staff and collaborators as "cutting-edge proof of concept site[s]" that would inspire museums themselves. Invigorating the external institution to employ more open, collaborative methods was a primary motivation. A SDDC facilitator explained their feeling that sites of this kind should act as precedents for new ways of working within the organisation; being at the cutting-edge, he said sites could act as "experimentation labs" to ensure a different future for everyone. A museum collaborator described his continual frustration with the glacial pace of change due to institutional hierarchies: "In terms of what we do at this museum, we're still baby-stepping in terms of technology used innovatively in its actual galleries. Why is it only allowed in this one room? Everyone's using classical methods still, ignoring this… so how do we get the rest of them to listen?" At the TDS, a manager relayed a more hopeful perspective: "We can't remove this room from its surrounding infrastructures. It was built to be a part of the museum. But helping the Tate become more experimental and open, when its departmental structures and architectures don't really support that, is an ongoing project – and an important one."

Conclusion

As a new generation of sites for making and learning practices have emerged in the U.K. with a focus on cultural collections, it has become possible to examine discourses of hegemony and reinterpretation that co-exist within the institutionalization process. It has also become possible to build an understanding of their unique circumstances, woven together from overlapping cosmopolitics of traditions, values and cultures. In exploring staff and user experiences at collections makerspaces within the Tate, the Wellcome Collection and the British Museum, this paper revealed evidence of canonical practices that were reminiscent to those found at other fourth-wave SMSs, from co-creation and group learning activities, to maintaining a sense of community amongst users, to the cautious equanimity of funder-site relations. Distinctive practices specific to the time-space continuum of the collections makerspace were also found, from a staff emphasis on good facilitation over the latest technologies, to deployments of remix as a

primary method for engaging with collections, to the influence of host institutions. As a result of these practices and their effects on the overlapping cosmos of sites and their institutions, this paper argues the collections makerspace is emerging as a critical field of institutional inquiry situated around tactical deployments of peer production practices.

As a fourth-wave actor in the U.K.'s tradition of shared machine shops, marked by a unique set of circumstances that foster the proliferation of both hegemonic and counterhegemonic discourses, the collections makerspace both perpetuates and reframes the legacies of its host institution. Through the use of experimental practices and concepts, the cosmopolitics of values and priorities between sites, funding bodies and institutions are always being renegotiated. In discussing a project in collaboration with an indigenous community from Australia, an artist and Tate collaborator explained to me how they had described their precolonial tradition of continually remaking their society's shared 'jukurrpa' (dreaming) histories through the creation and recreation of specialized paintings that depicted these traditions, the cultural expertise of which was shared collectively amongst the community. "This is the problem with institutions like the Tate," she explained. "They have historically taken our shared culture and they have made it elite, and we're supposed to feel they're now being generous – but I think something powerful about digital culture is it can allow people to make something of their own again. There is something about having these sites in cultural institutions, saying you need to remake this together with us to help it come alive again […] that's everything. *That's* the change." Perhaps it is in these meeting places of time and space, these emergent-yet-familiar constellations of artifacts and actors and practices, that collections makerspaces can help cultural institutions themselves come back to life, too.

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Notes

[1] This paper is informed by Yochai Benkler's (2006:60) characterisation of peer production as practices that are "decentralized, collaborative, and nonproprietary, based on sharing resources and outputs among widely distributed, loosely connected individuals who cooperate with each other without relying on either market signals or managerial commands."

[2] A method based on the belief that the role of museums in society needed to become more innovative and less elitist, allowing for new forms of expression and discourse and a redistribution of power (McCall and Gray 2013).

[3] Hooper-Greenhill & Moussouri (2000) describe free learning as a set of pedagogies that are non-sequential, self-paced, voluntary and free in choice, where users co-lead the learning experience alongside facilitators.

[4] A concept first developed by N. Bourriard in 1996 to describe interventionist artworks aimed at building social environments between artists and viewers to collaborate as a 'community'.

[5] Due to spatial and funding constraints, collections makerspaces typically do not carry largescale digital fabrication tools such as CNC routers or laser cutters, focusing more on digital design and lo-fi making tools, from tablets and printers to photographic equipment and crafting materials.

[6] A Living Lab can be defined as a collaborative working environment, usually situated within a city or geographic region, that builds from a private-public partnership to foster local, citizen-led innovations.

[7] While there are many variations, a hackathon can typically be defined as an intensive multiday event where a group of collaborators engage in (usually unpaid) labour for the rapid production of software, prototypes and other digital projects.

[8] Here I refer to Massey's definition of space as a site where the social is "stretched out" (2013: 3), brought to existence through multiple narratives, histories and social interactions that allow it to intersect with time.

[9] Here I refer to Science and Technology Studies.

[10] Evidence of hominid technology usage as seen through the development of stone tools can currently be dated to around 2.5 million years ago, around the same time the genus Homo appeared.

[11] Ascott defined 'telematic art' as art forms that combined computer-mediated technologies to network between individuals who were geographically dispersed while involving viewers as participants. In the 'Terminal Art' piece, participants would be able

to "tell the computer to turn up any mentions of giraffes and ice cream… the surrealists could have a field day." More at <http://telematic.walkerart.org/timeline/timeline_shanken.html>.

[12] Term used to describe works made in the 1990s-2000s that used the internet as a medium for critical exploration.

[13] Site is still available online as of 2018 at <http://www2.tate.org.uk/netart/mongrel/home/intro.htm>.

[14] By 'action research', I refer to the inclusion of generative or active outputs which are co-designed in collaboration with subjects. This may include the researcher and subjects swapping roles, sharing tools, building things and/or engaging in reciprocal sharing of materials, skills and ownership over the work (Pain 2003).

[15] Interviews were semi-structured around questions examining staff and collaborator perceptions of site practices, interactions and power relations, and ranged from 30 minutes to 2 hours in length. Questionnaires explored user perceptions and experiences, and were filled out and discussed during public workshops and events. Due to the confidential nature of interviews, all names have been anonymised, and titles have been replaced with the following general terms: 2) Site user; 2) Site collaborator; 3) Site facilitator; and 4) Site manager.

[16] Here I refer to the learner-centric approach to digital pedagogy that is based on the belief that learners construct knowledge through hands-on experience. For more, see texts like "The museum and the needs of the people" by George E. Hein at CECA: https://www.exploratorium.edu/education/ifi/constructivist-learning

[17] A digital archive of this data is openly available online as of 2018 at <http://digitalstudioremix.tumblr.com>.

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