

Reliving the Past & Making a Harmonious Society Today: A Study of Elderly Electronic Hackers in China

Yuling Sun, Silvia Lindtner, Xianghua Ding, Tun Lu, Ning Gu

School of Computer Science

Fudan University

Shanghai 201203, China

{yulingsun.lv, silvia.lindtner}@gmail.com, {dingx, lutun, ninggu}@fudan.edu.cn

Shanghai Key Laboratory of Data Science

Fudan University

Shanghai 201203, China

ABSTRACT

This paper tells a story of DIY (do it yourself) making that does not neatly fit more familiar narratives of making: as individual empowerment, as a democratizing force, and as technoscientific innovation. Drawing on ethnographic research with a collective of elderly electronic hackers in China, we provide insights into the socio-technical and politico-economic processes of hacking and making. This paper examines how the activity of making functioned for elderly DIY enthusiasts as way of remaking and reliving the past and as a means for expressing class belonging and citizenship. We show that making and hacking is not practiced in a void independent of social, political or economic forces. Rather, making unfolds in relation to, and is contingent on, societal norms and specific techno-cultural histories. As much as hacking empowers certain people, it excludes others and functions as a site for the exercise of power and social distinction making.

Author Keywords

DIY; elders; maker; hacker; China; values; culture; communities; collectives; politics; amateur expert.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Imagine a tiny apartment of a large high-rise building in Shanghai: the hallways and most of its rooms are filled with stacks of old analog radios, some with their cases open and wires sticking out, while others are seemingly untouched and function as devices of nostalgia, ranging from pocket radios to Wurlitzer type play stations, many dating back to post-world-war-II Europe. Amidst the stacks of devices one finds a workstation – a table filled with boxes, wires, an oscillator next to a soldering iron and voltmeter. A little further in, in the bedroom, a self-made bedside lamp fills



Figure 1. The home of an elderly radio hacker: Repair, collecting, and custom-made appliances.

the stuffed room with a warm and cozy light that automatically turns on and off depending on the time of the day (see Figure 1).

This scenario is typical of many of the home workshops of elderly electronic hackers (age 55 and older) we frequented on a regular basis as part of an ethnographic study we conducted in Shanghai, China over 1.5 years. Whether they repaired broken radios or modified an existing lamp to fit their needs, the elderly makers we worked with evidenced a familiarity with the tools and processes of “making” not dissimilar from the recent and growing academic and popular interest in DIY (do it yourself) making, hacking, tinkering, repair, customization, and so on.

In the fields of CSCW and HCI, DIY making and hacking are typically described as a multitude of creative practices including but not limited to building, repurposing and repairing artifacts without the aid of experts or professionals [18, 38]. Makers show off their creations at maker-related events such as the Maker Faire and come together at shared community spaces such as maker labs and hackerspaces. Prior work has shown that across these efforts, making has transformed from a hobbyist movement driven by geeks hacking away on the weekends into a nascent professional field that emerges in parallel to academic and industry research labs [30].

What pervades much of this prior work on making, hacking, repair and DIY culture, however, is a fairly utopian narrative [4, 38]. For instance, making is rendered as a new form of learning [23], savior of broken economies [10] and driver of innovation [9]. Often inexplicitly, DIY making is understood as something that young people do – or at least as something driven by a younger to middle-aged white collar working class society. With the notable exceptions of [19, 38], little prior work has explored sites of

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making that do not neatly fit popular stories of making as technological progress and creative expression. Our work fills this gap by providing insights into the making practices, visions, and aspirations of a collective of elderly electronic hackers in China.

While the so-called maker movement attracts a fairly affluent class of people in their thirties and forties [41], many of its proponents invoke their parent's generation, their fathers in particular, admired for their "authentic" engagement with making – a making with one's hands that's in touch with the affordances of physical materials, tools and machines. For instance, notorious figures in the so called "maker movement" such as Chris Anderson (former editor in chief of *Wired* magazine, now CEO of the DIY Drone company "3DRobotics"), Dale Dougherty (founder of *Make Magazine*), or Eric Pan (founder and CEO of *Seed Studio*) all have articulated that their work is in part motivated by the wish to return to earlier modes of technology production. While prior research has allowed us to understand more deeply the visions, motivations and practices of these members of contemporary maker culture, we know relatively little about other generations of technology enthusiasts and what motivated them. Turner and Douglas, based on historical analysis, have shown that the roots of contemporary hacker culture in the United States go back to the 1960s and 70s counterculture [40, 46]. In contrast, we explore, here, making and hacking motivated by necessity and making rather than a countercultural spirit.

What are the visions and practices of technology producers, who hack technologies out of necessity rather than out of a countercultural drive? What histories of hacking, other than those of US post-cold war technological innovation, can we trace?

In this paper, we provide an alternative story of technology production, grounded in our work with elderly electronic hackers in China, one that doesn't inherently equate making and hacking with values of individual empowerment, counterculture and democratization as heavily promoted by contemporary maker initiatives [6, 41]. For the elders we worked with, values and practices of making, hacking, tinkering with electronics and broadly adopting a DIY approach to life were rooted in childhood memories and personal histories of coming of age in China in the 1940s, 50s and 60s. During their coming of age, political slogans such as "finding a way to technology" [1] and "If you want something done right, do it yourself" [31] were common in China, encouraging people to explore technology and design by themselves. Similarly, during the period of the Cultural Revolution in the 1960s and 1970s, many educated urban youth in China were forced to move to the countryside to engage in physical labor, an experience that many of the elderly hackers we worked with shared and that significantly shaped their early encounter with and take on the role of technology in their lives. At the same time, their

tinkering and hacking work was motivated by their concerns for and engagement with contemporary Chinese society.

For the purposes of this paper, we refer to their practices variously as hacking and making, by which we neither wish to connote the at times negative meaning of hacking (as in: hacking illegally into a system) nor to suggest that the elderly self-identified as members of the contemporary maker movement as in *Make* magazine's use of the term. When we speak of our interlocutors as hackers, makers or DIY enthusiasts, we wish to highlight their commitment to principles of reuse and resourcefulness, a deep material engagement with electronic devices, and tinkering and play with electronics. These values and practices are not dissimilar from self-identified makers and hackers today.

Terms like 'hacking' and 'making' are often used interchangeably, although some associate a commercial interest with the term making [32]. Our own prior research as well as an emerging body of literature on these activities has shown that terms like hacking and making vary depending on the context in which they are invoked [26, 30, 32]. For instance, the term 'making' might be used to promote one's work to a wider audience, such as schools and governments, while 'hacking' often connotes a commitment to produce technology by opening up and building on top of pre-existing devices and artifacts rather than building from scratch. Often, both terms are used interchangeably. While some individuals identify more strongly with one or the other label (hacker or maker), there is no unified agreement of what counts as making but not as hacking and vice versa.

Our goal, here, then is to take seriously the kinds of hacking, making, tinkering, and repair work that the elderly perform and that unfold in parallel to and largely unnoticed by more popular self-identified makers and hackers. Throughout the paper, we shed light on the confluence of the technological, social and historical dimensions of hacking. We will explore the following three questions: What motivates elderly individuals to tinker with, make, hack, repair, and open up technology? How do their practices differ and/or relate to the global maker movement? What is the relationship between elders' electronic hacking projects and contemporary social and technological transformations in China?

This paper contributes to prior work on DIY, hacking, repair, and making in CSCW and adjacent fields, in three specific ways. First, this research demonstrates that making practices are multiple, rooted in people's specific social, historical, and economic backdrops. In other words, our research demonstrates that making and hacking practices are imbued with meaning that is socially, historically and culturally situated. Just as visions of a contemporary maker movement in the United States are rooted in a growing interest in revitalizing the American economy and bring back the "made in America" brand [30], making, hacking,

repair, and DIY practices of Chinese elders are tied to specific social and economic concerns unique to China. Second, we show that making and hacking in elderly populations is not necessarily disassociated from the digital. Instead, digital artifacts were front and center in the making and hacking activities of the elderly population that we studied. For example, participants in our fieldsites set up their own web forums to facilitate the emergence of a larger collective of like-minded electronic hackers. Thus, this research demonstrates that making and hacking in an elderly population does not exist outside or independent of information technology and software programming as is commonly expected of this population, but is instead deeply rooted and sustained through digital practices. Third and finally, we argue that CSCW researchers and practitioners must engage deeply and critically with contemporary promotions of making and hacking as a democratizing force and site of individual empowerment [34]. As much as hacking empowers certain people, it simultaneously excludes others and can function as a site through which social distinctions of class are enacted, playing into broader socio-cultural and socio-economic power dynamics.

In what follows, we first present a brief literature review of prior work on making, DIY, hacking and tinkering, followed by a detailed account of our research methods. We then present our main findings, with a particular focus on making practices as a site of collective social identity, memory practice, and engagement with the Chinese nation and society. We found that the motivation for elder making practices stems from their engagement with aspects of their childhood and coming of age, self-reflection and identity making practices, as well as China's modernization processes, politico-economic context. As we will show in this paper, the elders strongly believed that their hacking practice helps improve contemporary society and well being in China. Finally, in the discussion, we lay out the contributions of this work to CSCW by analyzing in depth the socio-cultural, socio-economic, technological and infrastructural aspects of making. We demonstrate how elderly hackers came together as a larger collective through their shared passion in electronic hacking and through their online communication practices.

RELATED WORK

DIY making practices have been broadly studied in CSCW, HCI, and related fields over the last decade. This scholarship reveals that many who identify with making, hacking, and DIY activities and movements more broadly are committed to resourcefulness, creativity, and a desire to build their own tools and devices rather than accepting those provided to consumers by large corporations. Across prior work, DIY, making, and hacking have been analyzed as a site of novel forms of engagement with diverse materials [8, 39] and community formation around lay expertise and open sharing [24, 25]. Diverse making practices have been explored, including disassembling [37], repairing [38], and the Chinese open manufacturing culture

shanzhai [27]. Researchers have highlighted the social and technological impact of making on design [24, 44, 45], education [12, 23], and well as entrepreneurship [10]. Kolko *et al.* [23], for instance, stress the educational value of hands-on and interdisciplinary engagement provided by making practices. Similarly, Tanenbaum *et al.* [43] describe these activities as a form of *democratizing technology*, focusing on the playfulness, utility and expressiveness in DIY making practice. It is important not to undervalue the quality and impact of artifacts produced via these modes of production. Past work has shown that technologies and products produced by DIY makers are often similar or even competitive to professional designers and research labs, particularly in fields such as open source 3D printing [17] and robotics [11].

While much of the early work on making and hacking has focused on its impact on education, the economy, and innovation, more recently a body of critical scholarship has emerged [4, 38, 41, 54]. This work has highlighted how making and hacking cultures, despite their narratives of open-ness and inclusiveness, are often exclusive in practice. For instance, participation of women and other minority populations remains low [38, 41, 54]. In addition, the increasing participation of corporations, venture capitalists and governments, has begun to shape making and hacking collectives, increasingly giving such institutions external to the maker community large sway over access to tools and other resources [26]. As a point of example, take the sponsorship of Maker Faires by companies and organizations such as Intel, Ford, Disney, and DARPA, to name just a few.

Our approach in the research presented here is aligned with the growing body of work that draws attention to sites of making outside of hackerspaces, Maker Faires, and other fairly recent and popular avenues of making and tinkering. In this paper, we explore an idiosyncratic site of hacking and making, elderly hacking cultures, to help us understand making and hacking practices in new ways. In particular, we build on prior work by [4, 16, 19, 38] that has begun to draw attention to the kinds of making and hacking practices usually rendered invisible to stories of technological progress and innovation. Jackson *et al.* for instance, highlight, that practices such as maintenance and repair are to a large extent "rendered invisible under our normal modes of picturing and theorizing technology" and are marginal activities to "a Western and productivist imagination" [18]. At the same time, as [38] demonstrate, repair and maintenance have also become the site of first-world intervention in the Global South, rooted in an idealization of repair promoted as site of empowerment and sustainability amidst a culture of planned obsolescence and passive consumption. Studies such as [38] on the one laptop per child program in South America found that repair work is branded as a solution to localizing technology and educating underprivileged populations about technology. Specifics of local contingencies such as shortages of

resources as well as pre-existing repair and making cultures are rarely taken into account.

Building on this prior work, we wish to draw attention to practices of repairing, fixing, hacking, collecting, and redesigning of existing or even outdated technology. Although the elders in our study aligned in their values of sustainability and resourcefulness with a broader innovation and creativity discourse, their work remained invisible to the sources of funding that enable projects such as One Laptop Per Child [51] or hackerspaces as innovation houses [30]. We also extend from this prior research by tracing historical roots of contemporary hacking and making practices other than more familiar stories of US counterculture and IT innovation. Repairing, reusing and redesigning of old and malfunctioning technologies was a common virtue the Chinese government heavily promoted in the 1950s, 60s, and 70s. For the elders we worked with, a DIY approach towards life and technology production, hence, provides a site not just for material production but also a means to relate to the past and to make sense of contemporary social and technological transformations in China. Thus, this case study of elderly electronic hackers gives a glimpse into a much larger technological and cultural practice of making-do and DIY out of necessity that shapes Chinese society and economy from the past through present-day [15, 26]. Members of China's contemporary hackerspace and maker culture, for instance, invoke China's unique history of technology production, making-do and manufacturing as a form of "hacking with Chinese characteristics [26]. By tracing some of these alternative histories of making and hacking and the experiences of those who have lived through them, we hope to avoid mapping onto our fieldsites in China a global narrative of hacker and DIY maker culture that inevitably equates it – as common in both popular journalism and academic scholarship – with the history of the US counterculture movement.

RESEARCH SITES AND METHODS

We draw from long-term ethnographic research conducted over 1.5 years, spanning both online and offline sites traversed by elderly electronic hackers in China. We employed a range of qualitative methods, including semi-structure interviews, participant-observations of online and offline gatherings and at home workshops and studios. Our research began when we came across a series of online forums populated by a collective of passionate radio hackers. These included: 1) the "Radio Forum," founded in the 1990s, it has today more than three hundred thousand users and is also known as the "worldwide group of Chinese radio network amateurs." 2) The "New World Wireless Forum," founded in 2007, it has over three thousand users, whose majority are elderly electronic hackers from Shanghai. 3) The "Crystal Radio Forum," founded in 2000, it has around 186 thousand users and draws in specifically those who hack and repurpose old electronics and radios. These three forums provided platforms for people to show off their creations,

communicate with others about collecting and repair work, provide advice for others or receive answers to technical questions, and so forth.

By engaging with the members of these forums, the first author, a native Mandarin speaker, began to establish rapport with the founders and organizers of the websites, subsequently being invited to a series of offline gatherings and events. Throughout our ethnographic research, we interacted and observed more than 100 elderly electronic hackers. Over time, we began following more closely the work of 22 hackers, including, for instance, radio hackers, radio collectors, the software developer of the "Radio Forum," the organizers and participants in a regular offline gathering, and the employees of TECSUN Co. Ltd., a factory that manufactures radio network infrastructures in China.

Our 22 interlocutors were all male, with their age ranging from 46-78. 18 were more than 57 years old and 15 had already retired. They had worked/were working in a range of occupations including academia, education, civil service, journalism, management, as factory workers and service staff. Their educational backgrounds were diverse: while some had only primary school training others had university degrees.

All but two of our participants interacted with us regularly face-to-face in their homes, in their home studios, or in coffee houses. This format worked well for our study as it allowed us to observe first hand their technology productions, the materials and websites they used for repair work and hacking. They also shared with us the images and videos they had produced about their work over the last years. We conducted a series of semi-structured interviews, where we asked details about how they had first begin working with electronics, the specifics of their practice, tools and technologies they produced, as well as the kinds of online resources they relied upon. All interviews were conducted in Mandarin Chinese and later transcribed into Chinese and English for open and axial coding.

In addition to interviews and participant observation online and offline, we also followed two groups that had formed on Chinese instant message clients, focused on DIY making and radio hacking. We attended a series of informal meetings and offline gatherings: we hung out regularly at four elderly home studios, following their journeys to local electronics markets and TECSUN Co. Ltd., as well as their visits to the Xinghai Radio Network Museum (a museum about the history of radios, founded in 2012 by one of our interlocutors). Throughout our research, we used a grounded theory approach [42] to conduct analysis as we collected data. As themes began to emerge, we iteratively posed more questions around these themes in subsequent interviews and focus groups. When themes began to repeat themselves, we stopped the data collection process. The quotes used in this paper were translated from Chinese into

English by the first author, with the support by the second author. All of the names used are pseudonyms.

FINDINGS

It was common amongst our interlocutors to work with a diverse set of materials including but not limited to electronics, wood, plastic, and more. A central focus of production that many shared was the making of electronic equipment, crystal radios and television sets in particular. Many had begun to develop a passion for these technologies during their adolescence, when they often lacked access and financial means to these technologies. In what follows, we demonstrate how the elders' contemporary hacking and making practices are deeply rooted in their personal experiences of coming of age during a politico-economic climate of local shortages, political promotions of resourcefulness and a making-do mentality.

Histories of National DIY

In the 1950s, the Chinese government began promote what one might describe as a technoscientific maker ethos. A series of political slogans such as “finding a way to technology (向科技进军)” [1] and “if you want something done right, do it yourself (自己动手 丰衣足食)” [31] had become increasingly common. Across political discourse and economic reforms, technology was promoted as the crucial path to improve the strength and independence of the Chinese nation state.

Within this specific historical political climate, citizens were encouraged to build and implement their own technologies. Many of our interlocutors expressed that these political interventions had a strong influence on them. Childhood dreams of becoming a scientist or engineer were common. They had learned, early on, that their participation in the production of electronic technology was considered essential in furthering the economic development and independence of the Chinese nation state. During the periods of the Cultural Revolution in the 1960s and 70s, many urban youth were required to move to the countryside and make a living off of physical labor. Political propaganda during this time actively encouraged citizens to be self-reliant and to make and produce their own machines, infrastructures and resources needed for daily life and work. In addition, a pervasive lack of basic resources, brought with it a certain do it yourself mentality (or 自力更生 in Chinese), a hacking out of necessity or making-do, which – as our interlocutors told us – was understood as central in instilling a sense of individual and collective well-being. All of this, ranging from the political promotions of self-reliance to the lack of resources, had significantly impacted the elders' coming of age. Making and hacking of electronics was simultaneously source of income, site of socializing, and political propaganda.

Promotions of this DIY ethos remained, in altered form, also after the Cultural Revolution. Deng Xiaoping's

economic reforms of opening up in the 1970s and 80s, for instance, were ripe with promotions of a making-do mentality aimed at developing a scientific and technological force. Chinese citizens were encouraged to acquire technical ingenuity and a basic understanding of a variety of technological artifacts including but not limited to sound equipment, television, audio amplifiers, circuit structures and factory machineries.

Take 59-year old hacker Fang, for instance, whose knowledge in electronics had helped him get a significant promotion in his job. He was working at a famous landmark hotel in Shanghai at that time, and had noticed that an unusually high percentage of light bulbs burned out every month. He began to investigate the cause and redesigned the hotel's electronic circuitry, which not only reduced the overall power consumption of the hotel by 5%, but also – in his words – *“greatly improved the customer experience!”* And, he proudly continued: *“on top of it, because of the improvements I made, I got a promotion at work.”*

Many of the other elderly hackers, similar to Fang, had made a living off of their ingenuity of working with materials, tools and electronics. After retirement, they continued to make and fix electronics, but as retirees began to think of it more as a “lifestyle” choice and as something they did “just for fun”. While DIY making continued to be a predominant mode of living, it had turned into a leisure activity and a way of connecting to other like-minded elderly. Some made their own home appliances or electronic devices, which they preferred over purchasing the latest state-of-the-art products.

Although many told us with pride about their accomplishments, regardless of whether it was a materials-based solution to a problem encountered in a former job or a novel repair created in their homes, they distinguished their work from contemporary promotions of technological innovation. 52-year old Dan, for instance, who owns a home workshop, emphasized that the kinds of making practices he and his elderly peers conducted was different from the ways in which technology innovation is typically promoted in mainstream culture in China. He further elaborated that his work was not focused on a particular end goal, but on playfulness and tinkering: *Our form of DIY, from circuit board design to packaging, every process is designed based on how we like it. These DIY objects are treasures to me. I often buy old components from the flea markets, and then play with them. Making is a spiritual practice. I usually communicate about what I make with my peers, with other elders, and design with them, together. The whole process makes me happy and fulfilled.”*

Tinkering with electronics, here, functioned as a means to socialize with other like-minded peers and provided a sense of fulfillment. Others in our study reflected that their engagement with electronics today granted them the fulfillment of an old *“childhood dream.”* Many agreed it constituted a particular *“lifestyle”* that they shared with

people of the same age, or even a “valuable art.” To hack, remake, and repair old electronics, practices reminiscent of their coming of age, provided satisfaction, happiness, a sense of accomplishment and pride. Jin, 64, explained to us that the satisfaction he felt was “*not about the end result of having a physical artifact, but about every part of the process of making it.*” A particular prominent device that embodied this sense of reliving an old childhood dream was the 2P3 radio, a DIY radio kit that was sold in the 1950s and 60s to schools and individual households that could afford it. The kit contained the plastic casing of a portable pocket radio as well as the schematics of the electronic circuitry and components needed to make your own (see figure 2).

As children, only a few of the elderly could afford the components that went into building the radio. And so many shared a mutual passion to rebuild today the device that they had so much aspired during their coming of age. Many conducted weeks of tedious search for original components at electronic and flea markets throughout the city as well as online. Others began to design new features and add-ons to the old 2P3 radio, which – once accomplished – they showed off during the frequent offline gatherings. Hacking of electronics, here, functioned as a way to re-engage with and relive a particular aspect of the past, which we will examine in more detail next.



Figure 2. The image of the 2P3 radio, the schematics and the rebuilt version

Hacking as Memory Practice

A hacker ethos and DIY approach to technology production is often envisioned as a way to challenge passive models of consumption and produce alternative and potentially more resourceful technological innovations [30, 33, 52]. In contrast, for the elderly electronic hackers, making functioned less as a way to promote or imagine an alternative technological future, but as a memory practice aimed at making and remaking both China’s past and present [7]. For instance, what many in our study shared was the passion to repair and rework old and outdated technology including components such as electronic tubes, power amplifiers, transistors, and so on. To deeply understand and bring back to life what was old and discarded was considered in and of itself a valuable endeavor. The old was not something to overcome, but something to remobilize today.

A particular emphasis was put on preserving technologies of the past, including collecting, reusing and repairing

electronic materials and equipment. For example, most of our interlocutors had accumulated a large variety of diverse materials through scavenging surplus stores and flea markets and exchanging components and tools with peers. For many, these practices of collecting and reusing old discarded materials were articulated as a crucial way to “save” and record China’s history of technological development for the younger generations. Yu, for instance, had amassed an extensive collection of original electronics components, which he used to re-create exact copies of classic radio brands. He also improved and redesigned some of these devices into new and more advanced versions. Here, reuse, copy and redesign together constituted the means to both relive and remake the past.

Yu, and many others, expressed a concern that with the contemporary focus on “newness” important aspects of the past would be lost: “*Technology is becoming more developed today, and these old things will be eliminated. Young people in China, they like new things, and don’t care about these old things anymore. But for us, these old technologies are the most precious. I am very happy when I repair a classic radio. Of course, I know of high-end technology brands such as iPhone and iPad. I have them, but I rarely use them. They can be bought at any time and any place. But this old art of DIY making, people forget how to do it, and don’t know how to do anymore.*”

Many believed that this “old art of DIY making” was worth preserving as it functioned as a lens into China’s cultural heritage and history. Gang, 67, the founder and organizer of the “New World Wireless Forum”, told us, “*We are all amateurs. What we do can’t be compared to professional engineers. But nevertheless, you can learn about China’s history, culture, custom and even national characteristics from our DIY practice*”. Zhang, 72, a well-known radio collector in Shanghai, spent most of his retirement income to collect and repair classical radios from both China and abroad. He frequently invited visitors to his home to show off his collections and self-made creations. He dreams to have his collection featured in a museum with the goal to preserve, as he put it, a precious part of history: “*Once, a person wanted to use 5 million RMB [Chinese renminbi – Chinese currency] to buy my radios, but I refused. I want to denote my collection to our country and use it to remember and preserves this history, and let more people know, this is the Chinese radio culture and our technological history.*”

Some indeed managed to receive significant attention of their physical collections and creations, being reported in local media and news magazines [2, 3]. Others shared things online, including their creations, materials and step-by-step instructions. Yet others produced carefully crafted video records of their own repair and remake practices, many of which functioned as how-to tutorials, and shared them on Chinese video sharing platforms such as Youku and Tudou. Sharing practices were aimed at connecting to other like-minded collectors and hackers, but also at

promoting an aspect of China's techno-cultural past and preserve it for future generations.

Taken together, what we see here is how making, hacking, reuse, and repair functioned as a site of constructing a techno-cultural national and cultural identity for China by remembering a particular aspect of the past: a commitment to DIY making, resourcefulness and reuse, which many considered crucial for China's further development, however also feared being increasingly lost.

Building Your Own Smart Home: Mundane Forms of Innovation

Many believed that a commitment to reuse and resourcefulness was increasingly rare. What had become the norm, they elaborated, was conspicuous consumption and a loss of China's culture and tradition of sustainable living. A DIY approach had been an essential tactic of survival during their coming of age, but was something that young people today did not need or care about. While many of our interlocutors did not think of themselves as innovators, their attitudes and practices reflected many facets of contemporary maker and hackerspace culture. For instance, many elders believed that making was a site of empowerment and that one could only truly "own" technology if it was hacked and made by themselves: *"the iPhone or iPad, and the likes, are all designed for you by others. Those are really nice, but you don't own this technology."*

Many also built technological solutions quite similar to those currently promoted as the next generation of Internet enabled devices such as smart home applications. Take, for instance, Fang, who began to advance his own home with ubiquitous smart technology after he retired about 5 years ago (see figure 3). His apartment is enhanced with a series of add-ons and electronic improvements, which he described as follows: *"when we grew up, we shared an interest and ability in designing everything by ourselves. This is something that we are proud of. Take, for instance, my apartment. I designed the whole place by myself. A person who is into DIY can really apply this knowledge to every aspect of daily life. For instance, I design crystal radios as well as my apartment and repair all my household appliances."* Fang's approach to creating a smart home was focused predominantly on making small improvements – mundane forms of ingenuity aimed at improving his day-to-day living situation. For instance, he enhanced a bedside lamp with a sensor that replaced the standard switch and turned the light on and off based on motion and touch. For elders like him, he explained to us, the standard on-and-off switch was too small and not user friendly. He also added a safety light to his bathroom that automatically turned on and off based on people entering and leaving the room. He showed us how he had further improved an energy-saving light and redesigned a music player (see Figure 3).

While Fang did not attempt to turn his creations into actual products, some of the other elders had filed patents for their

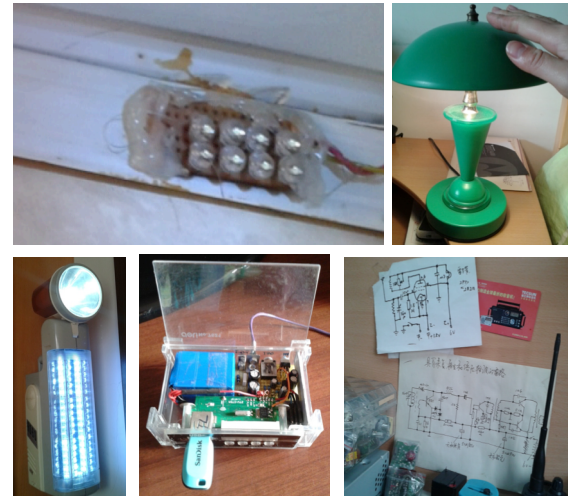


Figure 3. Fang's smart home creations and one design drawing

inventions (see Figure 4) or even published articles and books on the topic [48, 49]. Regardless of whether or not their hobbyist practice was specifically aimed at the advancement of scientific knowledge, all of the elders understood their creations as unique contributions to Chinese society. They strongly believed that their DIY practices made them members of a collective of elders that constituted a productive force in society, which many emphasized was of particular importance as they transitioned into retirement. In the next section, we will discuss in greater detail how making and hacking gave elders a sense of contributing back to society and to the nation's future development.

Collective Identity Practice: "We are a High-quality Population"

Many of our interlocutors thought of themselves as members of a larger collective, who shared a cultural mindset, upbringing, and approach towards life, technology, and society. A sense of collective identity was continuously reinforced through both online and offline interaction. By collective, here, we refer to prior work from media studies that has demonstrated how people, who do not necessarily personally know one another, identify as members of a larger like-minded collective [29, 47, 50]. Prior work has examined how the *use and consumption* of analog media such as newspapers [50] and digital media [47] can forge the formation of larger collectives. Here, we focus on the ways in which the *production* of technological artifacts can also function as site of cultural production and collective



Figure 4. Dian's patented products

identity formation.

Across our interactions and conversations, many agreed that they belonged to a population of “*higher quality*.” They believed that those with technological skills were of a “*social elite*,” contributing to China’s social and economic development. They emphasized that people “like them” would not be driven to hack out of economic interest or to make a huge profit, but out of curiosity and a genuine interest for the inner workings of technology. Amongst their peers, they openly shared designs, sources, and schematics of the kinds of devices they made. This was something, they agreed, not everyone would readily do, but only people of a “*certain personality*” would practice. Reputation and social recognition by others were central aspects.

Many believed that DIY making was particularly apt to help bond people and allow them to develop trust to one another, something many considered very difficult and rare in China. Many told us that prior to their engagement with the online radio and electronics community, they had often felt isolated. Few had stayed in touch with acquaintances from work and expressed that generally they believed it was hard to trust and build friendships to strangers in China, or as Liu emphasized: “*The radio group is very important for me. You know, having a sincere friend is very hard to find in this society.*” The founder of the online Radio Forum, similarly, told us that his main motivation for setting up an online platform for passionate radio hackers was less so driven by his technological interest, but by the goal to connect to other like-minded people.

Some also began collaborations with the aforementioned TECSUN Company, testing its products and improving electronic equipment. We interviewed an employee at TECSUN, who expressed how much his company valued the collective of elders: “*Communication with this group of elderly is very useful to our company. When we design a new radio, their suggestions and user experience tests are helpful for us to improve our product. We usually ask them for advice in the form of questionnaire or through the online forum.*”

Many shared the belief that these online sharing practices did not only provide people with personal fulfillment and important social connections at an older age, but could also improve society as a whole. They distinguished their work in particular from other elders, who would spend their time playing games, drinking, and watching TV, activities which they regarded as harmful to the healthy and harmonious development of Chinese society. In contrast, DIY making, they argued, was a *healthy* activity and *valuable* to society that could improve people’s well-being and social stability. Take for instance 59-year old Chang, the organizer of the online Radio Network community, when he argued that: “*DIY making is very healthy for elderly people. We get to meet many people through this. We are not alone. We are high quality people, in comparison with others who like to*

smoke and drink. DIY making gives us something to do and can avoid that elders become a burden for society. I believe that we are helpful to social stability and harmony.”

These notions of a quality workforce and its connections to social harmony, as anthropologist Aihwa Ong [35] observed, are laden with meaning. As a narrative of Chinese modernity, the notion of harmonious society gained force under Deng Xiaoping, being promoted as a moral force. The notion has been used ever since to justify a series of regulatory measurements, including Internet censorship, promoted as the necessary means to avoid Internet addiction and “unhealthy” development of China’s youth [28]. This notion of constructing a harmonious and healthy Chinese society is taken up by the elders and applied to their DIY making practices. DIY making and hacking becomes a marker of social status and class, rendering people engaged in electronic reuse, repair and production as socially distinct.

Open Source Sharing: the Role of Software & Hardware

All of our interlocutors were involved in both online and offline collaborative practices. Online practices included the sourcing of components (e.g. on Taobao or eBay), but also the sharing of how-to instructions, self-made devices, repair work as well as news articles, general advice and writings (e.g. on forums and social networking sites). People also networked offline, for instance, during their tours of flea and electronic markets in the search for components and materials, offline gatherings, and group visits to local museums. Friendships were fostered across both offline and online interactions, constituting together a peer-based open source environment that enabled collaborative tinkering and knowledge exchange.

Over time, these interactions lead to the exchange of information beyond engagement with electronics. The elderly shared worries about their families and children, politics as well as age-related concerns. Many emphasized that the collective was unique, because it was made of people who were committed to life-long learning, or as one person once posted online: “*we are never too old to learn.*” DIY making was considered a particularly effective way to learn, because it required knowledge exchange and collaboration. The elderly, so to say, were producers of their own smart homes and learning platforms. They installed software systems, retrieved information online, created and edited digital photos and videos, shopped online, and set up web services. Reflecting on these practices, they often told us humorously us that their drive for learning came from peer pressure, accompanied by a practice of exchanging favors and support.

We would like to emphasize, here, is the central role that software plays in making and hacking practices. Maker culture is often celebrated for its return to an engagement with physical materials, often thought of as more authentic and intuitive than an engagement with software code and digital materials. However, making and hacking practices

are often contingent on the writing of software code (*e.g.* to program the system that runs on a chip or microcontroller platform) and the use of online platforms (*e.g.* online repositories and file sharing platforms). Although our interlocutors did not write software for their electronic hacks, they did for the set up of online platforms and forums, crucial to the social organization of their hacking and sharing work.

DISCUSSION

Through our ethnographic research with elderly electronic hackers in China, we have drawn attention to the contingent aspects of making and hacking. We have shown that a deep engagement with technology production is not limited to the value systems, techniques and platforms of those who promote a contemporary maker movement rooted in US Internet counterculture. We have shed light on the particulars of a culture of technology producers, whose work is entangled with histories of production, cultural and socio-economic development in China. We have also shown how the elders' commitment to re-use of old and discarded technologies was wrapped up in a much larger politico-economic project dating back to periods of the Cultural Revolution that promoted self-reliance and resourcefulness as a virtue for Chinese citizens.

While electronic hacking constituted a site of open collaboration, individual fulfillment and social networking, it simultaneously functioned as a site of distinction making, whilst peers not engaged in technology production were rendered of lower quality and as contributing less to the healthy and harmonious development of Chinese society. In what follows, we discuss in more detail these sociotechnical and politico-economic processes of hacking we observed. Hacking is by no means void of politics or a practice that is inherently outside of or removed from wider systems of power. We also discuss the importance of understanding contemporary making and hacking cultures in relation to local histories of making. We believe that these findings have important implications for how CSCW approaches questions of making, hacking, tinkering, and materiality.

Histories of Hacking

We have demonstrated in this paper that making cultures are rooted in specific local histories of techno-cultural, political and economic processes. Making and hacking is often thought of as a global practice that spans across and connects geeks across multiple regions [20]. Recently, the vision of a rising global maker movement has instilled a particular kind of imaginary of what counts as hacking, DIY and making and who counts as a maker or hacker. For instance, the hacking of electronics, and the hacking of radio technology in particular, is often associated with a countercultural ethos, *i.e.* a commitment to the creation and spread of information that challenges top-down state broadcasting media. When people promote hacking and making today, they often invoke earlier generations of tinkers. Think, for instance, of how radio hackers such as

the "Hams," as Kristen Haring [14] documents so well, figure in a wider public imaginary about technological ingenuity and creative expression.

We have documented, in this paper, the values and practices of a hacking culture that emerged independently from better-known stories of open-source geeks, countercultural hackers and hardware enthusiasts in the West. In doing so, we have also shown how making and hacking proliferates beyond familiar sites of technology production. At the same time, we have demonstrated that making and hacking, counter to a common rhetoric of empowerment, inclusivity and open-ness, is an exclusive practice and site of distinction making. For our interlocutors, repairing of old radios and tinkering with electronics was a means to position themselves as a productive force in contemporary Chinese society. Hacking, here, was the site to express and enact citizenship that rested on one's social and technological abilities.

In this sense, hacking for our interlocutors was a site of empowerment in low-resource workplaces situated in a specific political and cultural moment of Chinese history. Thus, hacking has figured prominently into their understanding of their individual worth over the life course, and this sense of technologically-based self worth remains after retirement. Further, through their hacking practices, the elders in our study found a like-minded collective of peers, enabling them to discuss personal concerns and worries and reflect on ongoing changes in Chinese society and the economy. They did not think of themselves as isolated from society nor did they think of themselves as weak or in need of new technologies. On the contrary, they strongly believed that their DIY approach towards technology production and life more broadly has value to society. Their hacking, repair and making practices were oriented in parts towards sustaining a particular aspect of Chinese history and Chinese cultural tradition – a DIY ethos that they experienced as central to Chinese society during their coming of age.

CSCW researchers have long been concerned with the interweaving of technological and social processes. They have shown that technologies are neither fixed in a particular point in time nor isolated from the people, who develop, use, and shape technology, *e.g.* [13, 21, 22, 36]. Our study of the social, historical, and technological processes of DIY hacking and making contributes to this sociotechnical systems research. What we would like to emphasize, here, in particular is the importance of engaging with historical processes of design and technology production. Thus, we wish to re-open the question of sociotechnical systems by investigating how the social and technological come together with regards to people's varying social and economic positions over time. Technologies, their use and their design, are contingent on specific historical moments and processes. Individual life stories, memories and experiences are wrapped up in these

technological changes over time, and impact technology production and use today. As we have shown in this paper, hacking and repairing constituted for the elders an act of reliving and re-evaluating their past as Chinese tradition. Further, the elders used hacking and making to urge others, particularly younger generations, to take participation in a shared cultural heritage seriously as a virtue. Technology production, here, is not only socially and culturally contingent, but tied up with deeply personal and emotional re-engagements with the past.

Politics of Making

Those who promote the rise of a contemporary maker movement often portray making as a democratizing force and site of individual empowerment amidst a pervasive passive consumer culture and corporate control [5]. These values of individual empowerment are inscribed into the technologies produced: for instance, open source hardware kits are designed to help proliferate making and hacking and enable many to design their own systems.

With the notable exceptions of [4, 18, 38], there is little reflective engagement amongst practitioners and scholars, who promote making and hacking as a new educational or economic force, with the kinds of values and ideologies they themselves inscribe in the products or open hardware solutions they design. In this paper, we have shown that hacking and making has politics – today as much as in the past. A multitude of stakeholders, ranging from technology producers such as the elderly electronic hackers we worked with, all the way to governments and corporations, all meddle with and shape infrastructures of technology production. Beyond the immediate confines of our fieldsite, prior research has shown that making and hacking has drawn significant attention and investment from governments (e.g. both the US and China) as well as corporations such as Intel and Foxconn [26]. As researchers and designers of technological systems, we have to consider these many other players involved in designing and shaping technologies, their value systems and agendas.

Winner [53] once argued that technologies are deeply interwoven in the conditions of modern politics, shaping and being shaped by the exercise of power and the experience of citizenship. Our research draws attention specifically to how processes of technology production – not just things but the *making of things* – are expressions of citizenship, power and class. DIY making and hacking, as such, is neither solely a democratizing force [43] in and of itself, nor is it necessarily a site of (democratized) individual empowerment [34]. Rather, as much as it empowers certain people, hacking and making also functions as a practice of exclusion, a site through which power is exercised via enactment and preservation of social-cultural and socio-economic class distinctions.

CONCLUSION

As practices of making and hacking receive increasing interest from scholars, politicians, investors, and

corporations alike, it becomes increasingly important to understand cultures of making in practice. In this paper, we report findings from ethnographic research with elderly electronic hackers in China. We document their motivations, aspirations and technological creations, with a particular focus on the historical and politico-economic processes that shaped their work. The paper challenges more common narratives of making as a global democratizing force and site of individual empowerment across regions, socio-economic class, gender, and so on. We ground our investigation in an analysis of the history and politics of DIY in China, relating our ethnographic findings to historical and discourse analysis. We also draw from prior work in media studies in order to show how hacking emerged as a productive force for the elderly we worked with, enabling them to exercise social status, trust and collective identity. We end the paper with a call for CSCW practitioners and researchers to ground future work on making and hacking in a deep engagement with both the histories and politics of making.

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