Inventive Leisure Practices: Understanding hacking communities as sites of sharing and innovation

Tricia Wang

University of San Diego

9500 Gilman Road

La Jolla, CA 92093, USA

tw at triciawang.com

Joseph 'Jofish' Kaye

Nokia Research Center

955 Page Mill Rd

Palo Alto, CA 94041

jofish.kaye at nokia.com

Abstract

Hacking, tinkering, DIY, and crafts are increasingly popular forms of leisure that have also become growing sites of study in HCI. In this work we take a wide view of the similarities and differences between these practices. We explore a broad spectrum of such activities, which we collectively describe as inventive leisure practices (ILP). We ask how members of various hacking communities make sense of their practice and involvement, and discuss 8 themes we found in common in hackers' practices. We conclude by proposing a working definition for ILPs.

Keywords

Leisure, hacking, tinkering, innovation, DIY

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

Introduction

OW Mileage Run: Part 1-HKG-IAD-YVR on CX in J. My girlfriend thinks I'm crazy, but here I am at the start of an extended mileage run which will see me flying 32260 miles in 102 hours. (FlyerTalk.com)

A look in the magazine rack of any large bookstore will serve to illustrate the remarkably broad spectrum of leisure practices today: in short, people do an enormous number of different things for fun. HCI has studied several of these leisure activities in some depth (see Brown & Barkhuus (2007) for an overview). In this paper we look at a set of leisure practices that involve creating new, improved or different devices or objects. These practices are often referred to as 'hacking' or 'tinkering'. Studies of hacking and tinkering practices in HCI to date have involved a wide range of topics. For example, Rosner & Bean (2009) have studied IKEA furniture hacking; Buechley et al. have discussed novel uses of the Lilypad Arduino (2008), and Sung et al. have investigated the personalization of the Roomba robotic vacuum cleaner (2009). These examples are analyzed as discrete sets of practices, and yet share certain characteristics: the initial use of a complete commercial product, the online exchange of expertise, an emphasis on skill acquisition through practice, a sense of resistance derived from using the product beyond its original intended function, and so on.

In this paper we unify these discussions of hacking practices by discussing the characteristics that such practices have in common, the differences between these practices, and the ways in which these practices can become sites of significant innovation. We are not alone in seeing these areas as ripe for study. Speaking to the design research community in a recent article in *interactions*, Diana discusses the richness of hacking and tinkering culture and its potential as a topic of study (2008), while others have discussed the role of DIY and craftwork as a topic for investigation in HCI (Buechley et. al. 2008). We believe that hacking communities are a particularly interesting example of 'small-w' work – work outside of the workplace – for study in CSCW. We found three threads of previous work that informed our research: work on hacking and tinkering, the role of crafts and craftsmanship, and study of leisure in HCI & CSCW.

Previous Work
Hacking, Tinkering, and User Modification
We use 'hacking' as a general-purpose term to describe what people do in the course of the inventive leisure practices that we studied. While this risks association with the types of destructive computer hacking practices epitomized by movies like *Wargames*, *Hackers* and *Swordfish* andperhaps more accurately termed 'cracking' (Levy 1984), it is a members' term, employed by those engaged in the practice. We deliberately try and limit our use of the word 'tinkering', as we feel this implies a trivialization of the practice. Hacking has been studied in HCI in a variety of ways: as re-appropriation in open source practices (Ducheneaut 2005) and programming (Beckwith et al. 2006), and in the context of DIY (Beuckly et. al. 2008). Others have studied hacking in a domestic setting: Wakkary & Maestri are one of many researchers who have discussed everyday hacking of the domestic environment (2007). Others have described small levels of change in existing technologies as 'personalization', such as the personalization of Roombas (Sung et al. 2009), and of IKEA products (Rosner & Bean 2009) or even an individual IKEA lamp (Saakes 2009).

There are also studies of such behaviors in the workplace. For example, Yardi & Poole surveyed two different technical support boards supporting a variety of technical levels of problem solving (Yardi & Poole

We read a wide spectrum of magazines for makers of various practices. These magazine topics included electronics hacking (*elektor, Nuts and Volts, Servo Magazine*) crafts and DIY (*Knitting, CardMaker, Make*) vehicle modification (*Honda Tuning, Garage Style, Mini Truckin'*), and culture jamming (*Adbusters*). In addition, we read some 75 papers from different fields and over 50 books, including how-to guides (Ikoe 2008, Wilhelm et al. 2008), journalistic, historical and critical studies of hacking, tinkering, and crafts (Levy 1984, Sennett 2008, Kline 2000), and management literature (von Hippel 2006).

2009) while Jones & Churchill examined a developer community around Yahoo! Pipes, a system for creating web-mashups (Jones & Churchill 2009); Jones and other colleagues are also some of the many researchers who have explored the mash-ups made possible by integrating Web 2.0 systems, and the support systems around those processes (Floyd et al. 2007). Other studies have also evaluated systems for supporting the music creation (Cook et al 2009), remix culture (Cheliotis & Yew 2009), and more generally user-generated [media] content (Obrist et al. 2008). All of these activities require levels of appropriation and re-appropriation that we found informative and supportive of our hypothesis that these were related kinds of behaviors.

Crafts
A second topic of particular study within HCI & CSCW revolves around the practice of craft. We discuss distinctions between craft and hacking later in this paper, but (as we will see) both practices have elements in common: a decoupling from market economies, elements of leisure practices, an emphasis on skill not accreditation, and an absence of centralized authority. Early work on crafts in the context of CSCW and HCI emphasized the changes to crafts and craftwork in the face of increasing computation (Blauvelt et al. 1999). More recently, Rosner and Ryoki (2009) & Rosner (2010) have studied knitting and craft communities, and Buechley etc. al. and colleagues have discussed the implications of the integration of digital components into textile development (2006).

Method
Inventive leisure activities are a complex and messy set of practices. As such, we felt it was important to study them in a variety of ways simultaneously to build up a rich understanding of the similarities and differences between them (Law 2004). Our methods included observations of online bulletin boards, interviews, and an extensive literature review of both commentary and primary sources. More specifically, we interviewed ten people who self-identified as hackers: three individuals who started a membership based hacking space with other 80 members and over 300 drop-in participants; one person who joined a hacking space, two leaders of the mobile python community; two people who currently manage a popular online space for makers; one person who leads an online hardware hacking kit business, and one person who was at one time very active in the car hacking community. Interviews were semi-structured, and ranged between brief chats of 15 minutes in one case, and over three hours in others, averaging about 90 minutes.

In addition to the sources discussed in the sidebar, we read and listened to interviews with and talks by leaders in the field (Fraudenfelder et al. 2010), and attended Maker Faire, an annual two-day long celebration of hacking, tinkering and craft cultures. functionality. In addition, we analyzed a section of an online forum for people who participate in mileage runs, a practice of taking airline flights with the sole intent of gaining maximum frequent flier miles for the minimal financial outlay, which has many similarities to other hacking behaviors we studied.

COMMONALITIES IN CREATIVE PRACTICES
We deliberately set out to explore a wide variety of practices under the rubric of hacking; in particular, we did not want to be limited by assumptions about the role of technology, or the kind of end result desired. For

Flyertalk is a bulletin board for frequent travellers to discuss airlines, frequent flier programs and related topics. We focused on the Mileage Run Forum, which describes its focus as "Discussion of methods to maximize miles and/or points either through trips dedicated to no other reason than the miles/points, or through creative alteration of trips to extend their earning capacity in often unique ways." http://www.flyertalk.com/forum/mileage-run-deals-372/

example, Saakes (2009) described making a large decorative lamp out of a small, inexpensive table lamp from IKEA called Lampan. The end result fitted his goal, and in return for a small monetary investment, his time, and some ingenuity, he was able to produce the large hanging lamp he needed. This is a quintessential innovative leisure practice.

We saw a parallel practice on the Mileage Run section of the FlyerTalk online bulletin board. A 'mileage run' is taking advantage of cheap fares to generate frequent flier miles. For example, a member of a frequent flier system may receive a particular elite status resulting in upgrades on future flights after she has flown 100,000 miles in a calendar year. If she has, say, flown 95,000 miles by November, then she may elect to find a cheap flight that can give her the remaining 5,000 miles and thus ensure that she gains her elite status. The destination may not matter – the forum is full of descriptions of mileage runners getting off the plane and then getting back on the same plane a few hours later to return home. Rather, the aim is to generate the most frequent flier miles (particularly those that count towards elite status requirements) for the minimum price. For example, we saw one user, "Bowgie", elated at a low transcontinental fare on Delta Airlines: *"I booked Halloween weekend, SAN-DTW-PHL-SLC-SAN for $186. That's 3.7 cents per elite status mile."* Much as Saakes was able to enlist the distribution and production system of IKEA, a large manufacturing company, to produce something tailored to his needs, Bowgie was able to use the distribution and production system of Delta, a large airline, to produce something tailored to his needs. It is through these identified parallels that we hope to make sense of the wide diversity of practices under the rubric of hacking.

In the course of this work, we were aware that it would be difficult to adequately represent the diverse ways that people expressed their feelings and intentions about their activity. Furthermore, when expressed, we found these categories slippery, changing, and difficult to abstract. As such, rather than force the practices we observed and discussed into tight categories, we discuss our findings under eight themes that our subjects used to discuss their relationship to their ILP. For reasons of space, we have generally had to limit our examples to one per theme, although each theme has resonance to varying degrees through our interviews, readings and studies.

We roughly order these themes from the most individual to the most communal. Our discussion starts with the interplay between of hacking and individuals' senses of identity, followed by hackers' expressions of the need for ongoing practice and skill, and the importance of reputation within hacking communities. We continue with a discussion of the role of resistance to authority in hacking, and other themes around the role of community in hacking: the varying degrees and varieties of participation, the importance of sharing, the idea of learning through teaching. Finally, we address the role of hacking communities themselves, and propose that many of the communities we address may in fact be better characterized as collectives.

Hacking as Identity
"I like to consider myself a 'Professional Minitrucker because everything in my life revolves around what I consider my way of life and that is living the minitrucker lifestyle" E. Macias, Mini Truckin Magazine, May'10, p82.

All names are aliases except for when subjects requested otherwise.

Instructables describes itself as the most popular how-to site for English speakers. Instructables allows users to post illustrated instructions for any type of activity, attracting a wide variety of people who identify themselves as hackers, makers, and DIYers. http://instructables.com

In one of our interviews, Yusuke, an experienced car modder who has owned over 15 cars in 8 years, described car modification or 'modding' as part of his identity. Car modding or tuning was popular in the small town in Japan he grew up in: he thought that *"he had tune cars to get a girlfriend"*. When he moved to Portland, Oregon to study English, he actively created a car modder identity for himself by buying a car and modifying it. He became involved in an online car modding community where modders of a specific car model shared and learnt modding tips. There was a strong sense of identifying with one's modded car: in this community, profile pictures were invariably pictures of the modder's car.

Yusuke moved to a smaller town in Oregon where there were other car modders. By this time, he had bought and sold at least eight different cars. He told us that a community of car modders *per se* did not exist, but rather that there were many individuals who modded cars. He would identify these individuals by driving around at night, looking for the visual and auditory markers of a car modder - tinted windows, gear shifting, engine revving - to race them on the street. Car racing with other car modders was an important part of fulfilling the identity of a car modder, and while he did not engage in face-to-face collaborations or discussions with other modders in his town, this form of participation was an important counterpart to his online engagement with his modder identity.

Skill
Hacking and craftwork prioritizes skill development and this takes through the hacker's or crafter's repetitive practice with the object of their activity. Repetition nurtures hacking skills. In our interviews with self-

identified hackers, they often spoke about how once they began their specific practice, they never stopped and that this is what they believed to set themselves apart from others who were "not hackers".

For example, we spoke to Raven, who is both an employee of and an active contributor to Instructables, which describes itself as the most popular how-to website for English speakers. Raven deconstructs clothing and reconstructs them for new wearable purposes. She said that "anyone" can do this, but what makes her a clothing hacker is that she just simply kept sewing and making, unlike others who stop after a lesson or a few attempts. For Raven, she sees her practice as one that is accessible -- but unlike others, she never stopped her practice

Reputation
Skill level is tied to reputation in hacking communities, but there is a level of complexity to the relationship. Managing reputation is a critical aspect of maintaining a community. Participation is negotiated between members and founders/managers, with reputation as one of the key sites of balance. For example, Christy, a community manager at Instructables, explains that Instructable's goal is to give a community enough space to develop, but also enough boundaries so that people are not "being mean" about another person's work.

For example, one subset of the Instructables users is the K'nex guns community. K'nex is a toy that uses plastic rods and connectors to build elaborate systems. The Instructables K'nex guns group is made up of Instructable users who share a passion for making K'nex guns that shoot rubber bands. The K'nex

community has developed an internal negotiation process for which K'nex models are the featured guns. The terms of negotiation fall along the lines of originality, cleverness, and clarity in instructions. The inclusion of a member's gun as featured, is a significant asset for a member's reputation.

Christy explained that reputation becomes more important as users become more personally and temporary involved by investing into their reputations online. This investment is measured by the numbers of Instructables they have authored, the comments they have received, and the number of people who have viewed their Instructables. When people make comments that violate the site's policy, they are sent a message that states their account has been put on a temporary suspension and it will be closed if they continue the behavior. She reported that when people do not have their reputation tied to the site, they will simply stop using their suspended account or they will make a new account where they can continue their behavior. But for those with a high investment in the site, their reputation is at risk if they do not with the site's commentating policies. These people will often reply with an apology, asking for a second chance and "begging" for their account to be unsuspended. She said this has happened several times within the K'nex guns group. She drew an explicit parallel between the comments left in Instructables with a strong tie to personal identity and anonymous commentators on Youtube, where there is no strong reputation system to support tighter communities with a corresponding decrease in the quality of comments (Blythe & Cairns 2009).

Resistance, repurposing and challenging authority
Many of the hackers we talked to and studied characterized their practice as involving resistance against some authority. This was discussed as characteristic of the difference between 'hacking' and crafts. Some hacking behaviors are characterized by a distinct sense of resistance against an authority. This sense of resistance can vary from the extreme end of anarchism against organized governance to resistance against a corporation to resistance against a dominant ideology. This is clearly a spectrum; for example, a knitter of a sweater may see their work as resistance to the commoditization of mainstream clothing. However, it's precisely this kind of members' categorization of their own activities that lends support to resistance as a theme.

Some hackers we spoke to specifically stated that they pursue activities that are outside of the intended uses by the manufacturer, and the active negotiation of the tension between intended and unintended uses is an active part of their community. Yusuke explained his practice of modding as something that *inadvertently* violated the car manufacturer's warranty policy. The unintentional result of modding his car was a violation of the manufacture's policy, although this was not his intent. Therefore, car owners who wanted the benefits of a warranty, while continuing to behave as a modder had to take alternative and creative steps to ensure that the they could hide their modding work. This dance around the warranty policy led to innovative practices of warranty avoidance.

Participation

Noisebridge is a hacker space in San Francisco, providing its members with resources such as a machine shop and an electronics lab, as well a social structure and mailing list. http://www.noisebridge.net.

Hacker Dojo is a hacker space in Mountain View, in Silicon Valley, about 45 minutes south of San Francisco. It provides space for coworking, for events, and for hanging out. http://hackerdojo.com.

We have defined the emergence of social groups around shared inventive leisure practices as an important aspect of these practices. Many people become interested in a practice through a hacking social group or they will meet others who are already involved in similar activities and then forming a group. How are norms of participation, sharing, and learning reproduced? How are these spaces always first and foremost for leisure activities? We can glean some insight into these questions by looking at how these groups enforce norms of what has been described as a "hacker ethos": sharing, problem solving, and improving (Levy 1984).

Somewhat to our surprise, we consistently heard interviewees express that active participation in a community was *not* obligatory to be a member. Our subjects all said that their communities did not penalize or pressure people to take part in the activities. So, for example, people who do not participate as authors or hackers are still a part of the community. In some cases, this is made explicit. For example, Instructables prominently displays the number of views for each Instructable how-to. By so doing they explicitly acknowledge the contribution of 'lurkers'), who view pages but do not comment or author how-tos (c.f. Brothers et. al. 1992; Whitaker 1998. There was general acknowledgement that not everyone has to be actively doing the activity of the group just as long as they are engaged in some way. Some people play the role of contributors and not active makers. In our interview, Anthony estimated that only 5% of Noisebridge members were actively working on a project. The other 95% hang around the space, come to meetings, and help others out. The representatives of both Noisebridge and Instructables said that it was

important that this was a space where people did not feel pressure to "make" or "submit" something. Anthony told us that people who hang around the space without a project play an important role too. They will often overhear someone who needs help and then they will chime in and provide their assistance. He also said that people's time commitments to projects vary throughout their membership and the founders of Noisebridge did not want to become the arbitrators of this process for they valued the input of people who weren't actively hacking on a project.

Sharing norms
Anthony and Raven, founding members of Noisebridge, described how members enforced their hacker ethos norms of sharing. The founding members were adamant that Noisebridge would be governed by consensus, and without any rules. The only guideline that everyone agreed to was "Be excellent to each other", a line from the 1989 movie *Bill & Ted's Excellent Adventure*. New members are introduced to this idea and are asked to follow the tenet based on their own interpretation and observed practices at Noisebridge. In another hacking space with similar norms of consensus building and sharing, Jeff, co-founder of Hacker Dojo, described an event when an outsider inadvertently tested the norms of open sharing by asking individuals to sign an NDA before sharing her idea: no one signed it because it "worked against" the culture and purpose of Hacker Dojo. Malcolm explained that the "culture of Hacker Dojo selects against hoarders." We heard similar stories from representatives of Noisebridge: for example, Andy explained that information hoarding does not happen often at Noisebridge because the person's reputation suffers as a result and so does their relationship with the community. Andy's point

forefronts the connection between one's reputation and their relationship to the community.

Learning through Teaching
While members of some communities explicitly emphasized learning the craft of the hack, others made no mention of this. But our evidence suggests these communities emerge to support non-traditional forms of learning framed as sharing. We see the importance of learning-through-teaching in the K'nex gun community Instructables. Members of the group post instructions for building different types of guns, and individuals help each other with constructing their models or improving upon a submitted design. Most of the forum discussion on each K'nex gun design is users who are having a trouble with constructing their gun. The author or another community member will reply back and offer advice for how to get over their hurdle. There's a strong sense of community in the K'nex gun group, and some sense of obligation to the group to return instruction to the community.

An interesting pattern that emerged at each level was the participation was the wide variety that was possible while maintaining a sense of identity. We articulated this by thinking carefully about the notion of "communities of practice" and contrasting it to a looser but perhaps more accurate notion for several of our objects of study of "collectives of practice"

Tighter communities vs. looser collectives
Wenger and Lave's concept of "communities of practice" is commonly invoked in CSCW and HCI as a term that refers to communities that come together to around a specific technological practice, whether it be gaming or programming (Wenger 1999). These communities allow for individuals to join a group,

contribute to the knowledge, and learn through their engagement. There is a defined practice and through "evolving forms of mutual engagement," (Wenger 1999 pg. 95), ideas are improved upon, and individuals figure out where they can make contributions. Several of the individuals we interviewed were part of or started communities of practices. For example, both Andy of Noisebridge and Jeff of Hacker Dojo spoke of their organization as a site of learning outside of the work place or a formal education site. These organizations not only generate knowledge, but they also generate identities that bind members to these communities.

Our studies, however, suggest that these hacker communities can range from the more familiar communities of practice to looser "collectives of practice." For example, we saw some people involved in hacking wireless routers that use the Broadcom chipset. There are some dozen or so variants of open-source replacement firmware for such routers (see http://en.wikibooks.org/wiki/Tomato_(firmware). Clearly, the individuals engaged in writing replacement firmware share a serious level of commitment to the community. Looking at the message boards, however, the vast majority of messages concern far more mundane questions: will this run on my router? How can I set this up under Windows, or from a Mac, or from my Netbook? Which firmware variant should I use? These are not from long-term users of the community; rather, they are short term, ephemeral members, using the community in the short time in a legitimate way as a source of information, but not contributing in the long term.

We make a case that communities of practice have stronger social ties and require more time commitments than collectives of practice. We refer to collective of practices as looser forms of associations for individuals whose participation is based on a more defined goal with finite time. These collectives still aggregate knowledge and facilitate sharing, but they are based less on long-term relationships and more on the immediate solution to solve. We believe that because these hacking communities are often times more ephemeral, they can be overlooked as serious sites of collaboration and cooperation.

Conclusions

The world of ILPs is rich and complex. As we have started to show here, it is hard to define. However, we have suggested eight characteristics of ILPs; steps, at least, towards a preliminary understanding of what unites this work and serves as a rich source of innovation and creativity. As research on hacking grows within HCI, we hope our proposed definitions provide key directions for future studies.

References

[1]   Bays, H., and M. Mowbray. 1999. "Cookies, Gift–Giving, and the Internet." *First Monday* 4. http://firstmonday.org/issues/issue4_11/bays/index.html

[2]   Blauvelt, G., Wrensch, T., and Eisenberg, M. 1999. Integrating craft materials and computation. In *Proc. C&C '99*. ACM, New York, NY, 50-56.

[3]   Buechley, L., Elumeze, N., and Eisenberg, M. Electronic/computational textiles and children's crafts. In *Proc of IDC '06*, 49--56. (2006).

[4]   Braverman, H. 1974. *Labor and monopoly capital.* Monthly Review Press.

[5]   Buechley, L., Rosner, D. K., Paulos, E., and Williams, A. 2009. DIY for CHI: methods, communities, and values of reuse and customization. In *Proc. CHI '09*. ACM, New York, NY, 4823-4826.

[6]   Blythe, M. and Cairns, P. 2009. Critical methods and user generated content: the iPhone on YouTube. *Proc. CHI '09.* ACM, New York, NY, 1467-1476.

[7]   Brothers, L., Hollan, J., Neilsen, J., et al. Supporting informal communication via ephemeral interest groups. *Proc. CSCW '92,* Nov. (1992), 84-90.

[8]   Brown, B. and Barkhuus, L. Leisure and CSCW: Special Edition. *CSCW 16*, 1-2 (2007).

[9]   Burrell, J. Evaluating Shared Access: social equality and the circulation of mobile phones in rural Uganda. *J.CMC* 15, 2 (2010), 230-250.

[10] Capurro, R. Passions of the Internet. In W. Palaver & P. Steinmair-Posel, *Passions in economy, politics, and the media in discussion with Christian theology*. Vienna: Lit Verlag, 331-345. 2005.

[11] Cheliotis, G. and Yew, J. 2009. An analysis of the social structure of remix culture. In *Proc. C&T '09* ACM, New York, NY, 165-174.

[12] Diana, C. 2008. How I learned to stop worrying and love the hackers. *interactions* 15, 2 (Mar. 2008), 46-49.

[13] Ducheneaut, N. Socialization in an open source software community: A socio-technical analysis. CSCW 14, 4 (2005), 323-368.

[14] Flowers, S. Harnessing the hackers: The emergence and exploitation of Outlaw Innovation, *Research Policy*, 37(2), March 2008, pp177-193

[15] Fraudenfelder, M., Dougherty, D. & Savage, A. "*Make It: How to DIY*", Commonwealth Club, San Francisco, 14 June 2010.

[16] Grudin, J. 1993. Interface: an evolving concept. *Commun. ACM* 36, 4 (Apr. 1993), 110-119.

[17] Ikoe, T. *Making Things Talk.* O'Reilly, 2007.

[18] Jenkins, H. 1989. *Textual Poachers.* Routledge, New York NY.

[19] Jones, M.C. & Churchill, E. Conversations in Developer Communities: a Preliminary Analysis of the Yahoo! Pipes Community. *Proc C&T '09.* (2009).

[20] Kline, R. *Consumers in the Country*. Hopkins, 2000.

[21] Law, J. After Method: Mess in Social Science Research. Routledge, 2004.

[22] Levy, S. 1984*. Hackers: Heroes of the Computer Revolution*. Penguin.

[23] Mauss, Marcel. 1954. *The gift: the form and reason for exchange in archaic societies*. W. W. Norton & Co.

[24] Obrist, M., Geerts, D., Brandtzæg, P. B., and Tscheligi, M. 2008. Design for creating, uploading and sharing user generated content. In *Ext. Abs. CHI '08*. ACM Press, (2008), 2391-2394.

[25] Pearson, Erika. 2007. "Digital gifts: Participation & gift exchange in LiveJournal communities." *First Monday* 12(5) http://firstmonday.org/issues/issue12_5/pearson/

[26] Prahalad, C.K., and M.S. Krishnan. 2008. *The New Age of Innovation: Driving Cocreated Value Through Global Networks*. McGraw-Hill.

[27] Rheingold, H. 1991. *The virtual community: homesteading on the electronic frontier.* MIT Press.

[28] Ritzer, George, and Nathan Jurgenson. 2010. "Production, Consumption, Prosumption: The nature of capitalism in the age of the digital 'prosumer'." *J. of Consumer Culture* 10:13-36.

[29] Rosner, Daniela K., & Kimiko Ryokai. 2009. "Reflections on Craft: Probing the Creative Process of Everyday Knitters. " *Proc C&C 2009,* 195-204

[30] Rosner, D. K. & Bean, J. 2009. "Learning from IKEA Hacking: "I'm Not One to Decoupage a Tabletop and Call It a Day. " *Proc. CHI 2009* pp. 419-422.

[31] Saakes, D. 2009. Big lampan lamps: designing for DIY. In *Proc C&C '09.* ACM, New York, NY, 403-404.

[32] Salovaara, A., Johnson, M., Toiskallio, K., Tiitta, S., & Turpeinen, M. Playmakers in multiplayer game communities. –*Proc. ACE '05*, ACM Press (2005), 334-337.

[33] Shirky, C. (2008) *Gin, Television, and Social Surplus.* http://www.shirky.com/herecomeseverybody/2008/04/looking-for-the-mouse.html

[34] Sennett, R. *The Craftsman*. Yale U. Press 2008.

[35] Sung, J., Grinter, R. E., and Christensen, H. I. 2009. "Pimp My Roomba": designing for personalization. In *Proc. CHI '09.* ACM, New York, NY, 193-196.

[36] Torrey, C., McDonald, D.W., Schilit, B.N., and Bly, S. How-To Pages: Informal Systems of Expertise Sharing. *IEEE Computer*, September (2007), 391-410.

[37] Torrey, C., Churchill, E., and McDonald, D. Learning How: The Search for Craft Knowledge on the Internet. *Proc. CHI'09,* ACM Press. 1371--1381. (2009).

[38] von Hippel, E. 2006. *Democratizing Innovation*. MIT Press.

[39] Wakkary, R, & L Maestri. 2007. The resourcefulness of everyday design. *Proc. C&C'07*, 163-172.

[40] Wenger, E. *Communities of practice: learning, meaning, and identity.* Cambridge, 1999.

[41] Wilhelm et al. *Best of Instructables.* O'Reilly 2008.

[42] Whittaker, S., Terveen, L., Hill, W., and Cherny, L. The dynamics of mass interaction. –*Proc. CSCW '98*, ACM Press (1998), 257-264.

[43] Yardi, S. and Poole, E. S. 2009. Please help!: patterns of personalization in an online tech support board. *Proc. C&T '09*. ACM, New York, NY, 285-294.

[44] Zachery, G. The African Hacker. *IEEE Spectrum,* August 2005.