The Early Micro User: Games writing, hardware hacking, and the will to mod

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ABSTRACT
Historical perspectives are largely absent from contemporary debates about user-making. In this paper, I approach the question of user and player making, historically. I consider what microcomputer users and players did in the 1980s, when digital games first became available to play. Excavating the practices of early users through historical research into game coding, hardware building and hacking places not only places practices such as game modification into a longer arc of cultural history of user activity. Exploring what early users did with computers also provides new perspectives on contemporary debates about users' productivity. The high degree of interest that contemporary users' productivity is generating in academic circles provides a wider context for such inquiries.

Keywords
Microcomputers, Users, Use, Coding, Programming, Hacking, Electronics, User-generated content, History, Australia, New Zealand

INTRODUCTION

> "After you have some experience making simple projects, you will want to design your own or make modifications to existing equipment."
> -- Eric Lindsay

Historical perspectives are largely absent from contemporary debates about user-making. The tendency to focus only on contemporary practices reaches its nadir in one university graduate course description which states: "The introduction of broadband, internet and mobile media have transformed audiences from passive consumers to creative consumer/producers of media content" (University of Western Sydney 2010). In this paper, I approach the question of user and player making, historically. Rather than viewing game modifiability, for instance, as a recent marketing solution intended to position a title as an emergent phenomenon by harnessing community labour and content, I consider what users and players did in the 1980s, when digital games first became available to play on microcomputers. Excavating the practices of early users through historical research not only places practices such as game modification within a longer arc of cultural theory and history; it goes to the heart of issues of use and users, providing new perspectives on contemporary debates about users' productivity and their experimentation with computing technology. The high degree of interest that contemporary users' productivity is generating in academic circles provides a wider

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context for such inquiries (eg. Banks, 2003; Jenkins, 2006; Marshall, 2004; van Dijck, 2009). Ultimately, my concern is with understanding the varieties of audience participation, and past practices can, I argue, provide valuable perspectives on these.

This paper comes out of research into the early domestic microcomputer scene in Australia and New Zealand, specifically the role of games and players during the 'long' 1980s. In 2009, I was awarded a Fellowship at the State Library of New South Wales, to research the production and consumption histories of digital games in 1980s Australia. For the archival research, I reviewed an extensive range of Australian primary source materials, including general and specialist computer newspapers (*The Sydney Morning Herald*, *Australian Microcomputer Magazine*, *Australian Computer Weekly*, *Pacific Computer Weekly*, *Australian Microcomputerworld*), computer magazines (*Your Computer: Magazine for business and pleasure*, *Online: The Microbee Owner's Journal*, *The Australian Commodore Review*, *The Australian Commodore and Amiga Review*, *The Australian Apple Review*, *Australian Home Computer GEM*), early code books, electronics magazines (*Electronics Today International*, *Electronics Australia*), hacker's handbooks, 'circuit cookbooks', instructional 'build your own videogames' books, and information on locally made kit computers. In this paper, I am supplementing archival research on games and microcomputing in Australia with insights drawn from ongoing oral history research on the local history of digital games in New Zealand, and theoretical questions about the figure of the user. The period of interest for this paper is from the late 1970s – when microcomputer systems first appeared[1] – to the mid-1980s.

We know that games were a significant use of home computers in the early micro- period. Software sales are reasonable indicators of this. Campbell-Kelly claims that "Games accounted for about 60 percent of [probably Northern hemisphere, probably early to mid-1980s] home computer software sales" (2003, 276). Later research by the ABS found that games were used in 62.1% of Australian households where a computer was frequently used (Australian Bureau of Statistics, 1994, 2). And games featured heavily in the *Australian Microcomputer Magazine*'s best-seller list of software for 1983, occupying all 10 spots on Atari's list, for instance ("1983's top sellers" 1984). But what do we know about the sort of practices that surrounded the actual playing of games in the early microcomputing era? As Joan Heemskerk of jodi makes clear, there are significant gaps in knowledge:

> So what did the home community do with these machines in the eighties? More than buying a cassette and playing a game. Actually, there's no information; we had to go to eBay, buy old analog ZX Spectrum Basic books, and try to find out ourselves. And we made a DVD out of it, to have the experience back of just fiddling around on a computer (2004).

In this paper, I will sketch a figure of the early computer user in terms of their productivity across both software and hardware domains. I will consider some of the explanations for these activities, before reflecting on some of the implications that emerge for theorising contemporary use.

I bring a media studies eye to the field of 1980s microcomputing, using games as a lens through which to view users' activities. My broad interest is in conceptions of audience and audience consumption and reception. I am interested in excavating the early history of computer use and the figure of the user in order to juxtapose this with, and contextualize, present day user activity. Many other theorists have, of course, attended to

audience/user productivity, devising various labels for the activities of users, hobbyists, readers, enthusiasts and others, including "prosumers", "Pro-Am" divides, "produsers", etc (eg Bruns, 2008; Jenkins, 1992; Marshall, 2004; de Certeau, 1984). It is worth noting that some of this work is intimately concerned with how production changes with digitality. For my part, I draw on the work of Michel de Certeau, particularly his attention to the uses that are made of products by consumers. The early user is one of the best examples of de Certeau's insight that users and consumers are makers and producers of culture. Yet, de Certeau – probably the key theorist of user productivity in cultural and media studies – makes no mention of computer users, despite the fact that Commodore, Tandy and Atari (to name but a few brands) all had had micros on the market for some years when *L'invention du quotidian* was published, in French, in 1980 (de Certeau 1984). Exploring this omission is beyond the scope of the present paper. Nor am I attempting a detailed media archaeology of user productivity (Huhtamo and Parikka 2011). Nevertheless, the activity I describe in this paper belongs to a longer lineage of experimentation and tinkering *with technology* (Douglas 1992, 1986; Haring 2007).

It seldom happens that anyone apart from historians of computing considers the computer user in a longer time frame. In the history of computing, the field of scholarship devoted to microcomputers is small, but it is notable just how often references to games and game players occur (Saarikoski and Suominen 2009; Veraart 2009; Campbell-Kelly and Aspray 2004; C. Lindsay 2003; Haddon 1988). As already noted, games were one of the main forms of software available for domestic use. I have found very little evidence of individuals who disliked playing games.[2] Whilst I cannot say that *all* users played games in this period, this paper takes *microcomputer users* as its focus, with the understanding that many users were involved – in one way or another – with digital games.

GAME CODING

Early users had to learn at least some programming commands, typically in the language BASIC, though some were committed to learning machine code. Users typically learnt some simple programming whilst playing games, especially in the early days as in order to play a game you either had to type in the source code, or type commands to load and run it. As New Zealand software developers Mark Sibly and Simon Armstrong explained:

> Mark: It was much easier in those days, because you turned on a computer and you basically had to program. That was all you could really do. So, the first thing you had to do was command to load a program and then run it (private communication).

Katharine Neil, another of my New Zealand informants remarked that in the 1980s, there was no point to engaging with a computer if you were not going to program.

> …you couldn't really do much with computers back then unless you learnt a bit of code. You'd do really dumb, primitive things, but… In those days, people bought games and they'd play games, but the coolest thing was to write stuff yourself. In those days, you bought a computer and you bought a book on how to program it, and there was only one way you could do it! And if you didn't do it, then what was the point of having a computer, because it didn't do anything, it didn't do anything for you (private communication).

Many early computer users wrote their own software. Users wrote various types of software, but, as Sharon France notes in her potted history of the Microbee computer,

most of them were games (1985: 24).[3] Writing games allowed users to develop their programming skills, and it was fun. Learning to code was often a process of trial and error, though there were many 'teach yourself to code' books available. John Perry was just 13 when he had his first game published ("City Lander, for the Sega SC3000, published by Grandstand). He described how he came to understand Basic as if he were "learning a new language".

> …you learn a 'word' -- a function, a command -- and you use that, and suddenly it changes all your programs, because suddenly you've got something that you can do. And then you learn some other trick. And generally I'd see someone use it in a program or something, and I'd look it up in a book sometimes, but mostly there was [no need for a book]. Mostly to start with you'd just copy the program and change a few little things to work out what was going on (private communication).

Fiona Beals found that the instruction book for her ZX Spectrum wasn't helpful, telling only how to set up the computer to type a letter. Beals found the Usborne range of books more useful, and, using these, she taught herself to program. To start with, she would type in other peoples' game programs. Then, similar to Perry, she began noticing other tricks and changing things around:

> Once I clicked onto what was happening with the book, I was able to go 'well actually I don't want it to do this', I want it to do that. I could start manipulating the code to do other stuff…

Like Perry, her experience was one of learning by doing, and this involved a fair bit of "fiddling around":

> When I was writing the code myself, I would always write 5 or 6 lines of code and then end it, and test it, run it and see how it would go (private communication).

Perry and Beals' teaching themselves to code was marked by what I am calling 'a will to mod'. In their cases, a modicum of self-study led to their tinkering around with, and modifying of program code until their programs worked as they wanted them to. Looking back, I find it interesting that coding was seen as a worthwhile skill to spend time learning, through self-study. It is hard to imagine children and young teens today sitting down and teaching themselves a new language, from books, simply for the sake of curiosity. Yet this seems to have been reasonably widespread at the time.

Some capable hobbyists used their coding skills and took advantage of the opportunity to cash in upon the release of a new computer for which little software existed. Campbell-Kelly sketches this as something of a cottage industry, writing: "The lack of significant barriers to entry led to the phenomenon of the 'bedroom coder'" (277). Natalie Filatoff's "Class of 1982" profiles a number of industrious teenagers who were making money in this way, writing programs. Michael Fackerell, Garry Epps and Martin Foord are Dynamic Software. Fackerell explains "It happens quite often…that computers are released before they have software ready". The trio had experience writing programs for the Apple, TRS and System 80, Compucolour and the Microbee, and were considering getting a VIC machine. "We've now got about eight programs for the Microbee…We're working all the time. They're mostly games at the moment" (1983, 27).

BUILD YOUR OWN COMPUTER

User invention, creation and experimentation were not confined to software. Computer hardware also provided users with many opportunities for creation and "fiddling around" (Heemskerk 2004). Indeed, a number of early hobbyist microcomputers came in electronic kit form, requiring that users first assemble them. Jamieson Rowe's EDUC-8 is the earliest Australian "'do-it-yourself' computer" (1974; E. Lindsay 1985). Other kit computers available to build in Australia included: the DREAM and the Microbee (from Applied Technology, the latter was distributed in several Scandinavian countries), the Super 80 (Tanton), and the Applix 1616 (Morton & Berger, 1986; Various, 1989).

New Zealanders Neil Breen and Selwyn Arrow both built their own computers early on. Breen worked as a programmer for the (little known) New Zealand office of the (very well known) arcade games manufacturer, Taito. He recalls:

> I was building my first computer as an amateur on veroboard in 1976. I built several machines for myself. My wife was running the local Plunket membership lists on a Z80-based machine with probably about 16k of RAM in the late 1970s (private communication).

Paralleling those who wrote games and sold them, Breen also built computers to sell onto others as a "sideline" when he was working for Taito.

When I asked Selwyn Arrow what his first computer was, he explained "well, I started to build one in the late 1970s, just out of bits and pieces, which is what you had to do in those days. I got the keyboard done." He'd gotten the impetus from reading *Byte* magazine:

> It was either Christmas 77 or 78, more likely 1978…A copy of *Byte* magazine arrived…I read it twice, including all the ads. It just opened up a whole new world…
>
> I had decided that I would start with peripherals and then eventually we'd sort things out. I was planning on using sockets and connectors and things that were surplus at work, you see, old bits, to make cards that plugged in. And eventually I realised there was this S100 interface, which meant that it was a socket with 100 pins. Eventually I dropped that one… But in the meantime I was studying a book on microprocessors – the Z80 – which of course was in the [first computer he bought, the Exidy] Sorcerer. So I wasn't wasting my time totally. I had this wonderfully large – by today's standards – keyboard with all the bells and whistles on it. I never really used it in warfare….I took it apart eventually. (private communication)

Arrow – who said he had more or less retreated into a corner of the lounge room for 2 years, which was how long it took him to learn about the computer and undertake the voluntary positions he held with the NZ Microcomputer Club – said his wife was very understanding of his new found fascination with computers, and even shared in it to some degree. She had grown up in a family of car enthusiasts and so "was used to becoming involved in projects", as he put it. As the child of a car enthusiast myself, I think I recognise something of a shared 'drive' between auto and computer tinkering: it is partly a need to be working with one's hands technically, putting skills to some good use.

Sometimes, the curiosity which drives the will to mod is more accurately described as a compulsion, as in the epithet from Lindsay, cited above: "After you have some experience…you will want to design your own..."

The experimental, curiosity-driven nature of Arrow's endeavours is echoed in magazine accounts of people building computers, including the unpredictability of the results. One article in *Electronics Today International* (*ETI*) featured both Eric Lindsay and Tom Moffatt describing the experiences and problems each had building their Microbee. Lindsay bought one of the earliest kits and after much labour, had to send the kit back to the manufacturer. "They spent about four days on it before also giving up. The offending board was returned to the supplier as an example of problems, and with a new board my MicroBee started running and has been trouble-free since." By contrast, Moffatt's initial construction was trouble free, but,

> Within an hour of completion, the first problem surfaced: heat, and lots of it… There is an old rule of thumb in the electronics business,…if a part is too hot to touch, it's too hot! Just about every active part of the power supply produced painful burns. Inquiries to Applied Technology brought the response that 'all the parts were running within their ratings'. [My friend] J.J. and I, being of a more conservative nature, found a source of Sinclair ZX81 plugpacks rated at 9.5 V/1.2 A… Another Hobart MicroBee user didn't get there in time – his 12 V plugpack 'blew its guts' (1982).

Such accounts provided would-be builders with the benefits of someone else's experience, and the sometimes unauthorised mods they devised. Reading such accounts, it was not expected that readers would already possess the skills required to build their own computers. What does seem to have been expected was that they would go and acquire these skills, that is, that readers would *have a go* at piecing together a working understanding of the knowledge and principles that were described, for themselves. Reviewing and comparing several electronics books, Lindsay particularly recommended those which emphasise a practical approach:

> Unfortunately the only way to really learn digital electronics is to build things, and keep working at them until they work. This can be a considerable problem for the beginner, since there is often no one to turn to when things go wrong — and they always do go wrong! (E. Lindsay 1983)

Doing rather than simply reading, Lindsay opined, would ensure that beginners acquired some experience in building, a familiarity with circuits and what they should be doing, as well as experience in how to fix them.

Even before the popular take-off of microcomputers, there had been an earlier moment when games and electronics were linked in domestic contexts when a range of 'how to' books invited readers to build their own games console. During the late 1970s, a number of books unpacked the intricacies of TV game devices. Len Buckwalter's title *Video Games* demonstrated how cellophane screen overlays could be used to "make your own game" (1977). Two years later, Walter Buchsbaum and Robert Mauro's quite extraordinary electronic engineering and hobbyist how-to guide appeared. Called *Electronic Games: Design, Programming, and Troubleshooting*, Buchsbaum and Mauro break down the different elements of electronics involved in such games, claiming that: "Engineers, students, technicians, and competent hobbyists who already know electronics

will find in this book all the information they need to design, program, maintain, and troubleshoot all types of electronic games" (ix).

HARDWARE HACKING

Not everyone built their own computer, of course. Microbees, though initially available as kits, were later available to purchase fully assembled. But even allowing for this, the archival material suggests that early users messed around with computer hardware to a much greater degree than is typical now. There was a willingness to have a go: in Auckland, for instance, the Combined Microcomputer Users Group organised a cooperative modem project, which allowed for the manufacture of low cost acoustic modems (Arrow, 1985, 110). In Australia, many projects on how to modify a computer were published in the pages of electronics (and some computer) magazines in the 1980s. These included attaching peripherals and other hardware interventions, to satisfy those who might desire a hard copy printout cheaply, or a joystick for playing games, or who wished to overclock their computer, or any one of a large number of other possible 'enhancements', for which circuit diagrams and instructions were typically provided. *ETI* published supplements that gathered together a range of circuit and design ideas in a 'circuit cookbook' – some but not all of which had been previously published in their magazines (Various 1985). Such projects and cookbooks further encouraged a tinkerer's or – as it was then known – a hacker's ethic in earlier computer culture (Richardson, 1985).

Hacking was a term frequently used to describe the bringing together of various items of hardware, a creative tinkering with computers, adding and extending their capabilities. The Microbee was, in particular, actively marketed in terms of its ability to be modified and 'hacked'. By the end of 1983, Applied Technology were extolling the benefits of the Series 2 – actually called the 'Experimenter' – with a remarkable advertisement featuring a robot arm (presumably interfaced with a Microbee) pouring a cup of tea for its operator (Figure 1).

Figure 1: Advertisement from *Online*, late 1983.

Supporting users to extend their Microbees were the magazine *Online: the Microbee Owner's Journal*, and surrounding publications such as the *Microbee Hacker's Handbook*, which promised "Hard and soft projects for Bees of all vintages. For Bee owners who like to …. Put their soldering irons to use"(Anon.). An ad for the *Hacker's Handbook* is shown in Figure 2.

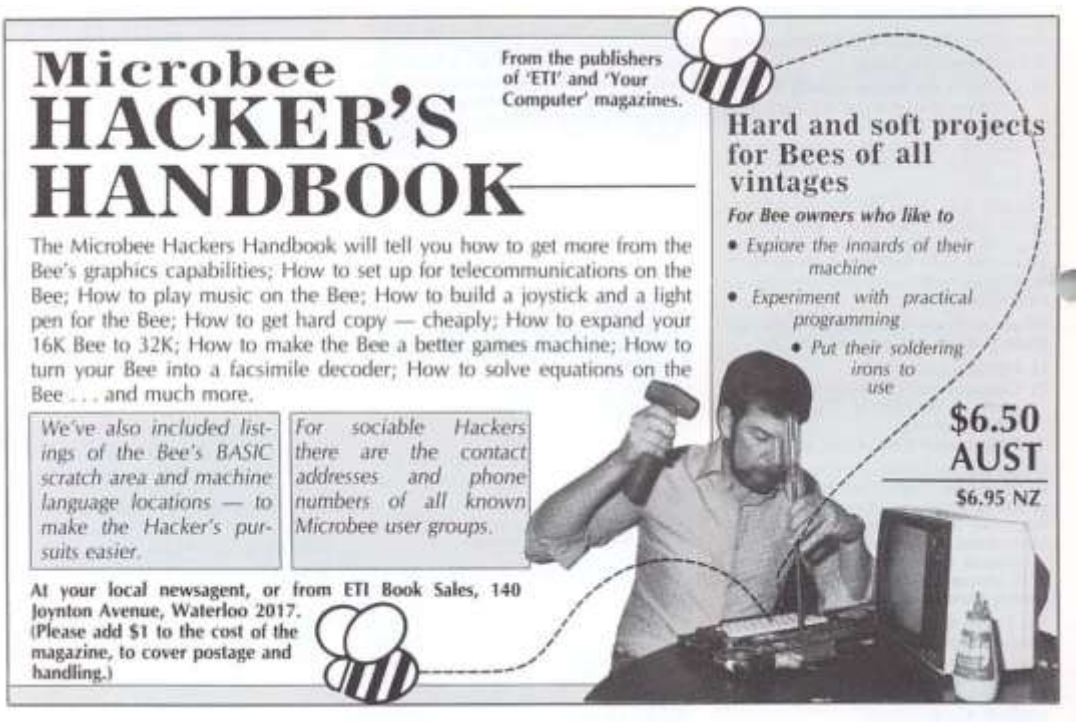

Figure 2: Advertisement from *Online*, October 1984, p. 40.

WILL TO MOD

The above advertisement, and the *Hacker's Handbook* itself, point to the existence of a strong electronics and engineering ethos in early computer culture. The reference to soldering irons, as well as the humorous depiction of hacking contained within the ad – a man taking to a computer's innards with a mallet and screwdriver– once again highlights the fact that these users are interacting with computer hardware. Published in 1985, the *Hacker's Handbook* gave a humorous portrait of the obsessive hacker who was forever "Adding Things On" to their computer. It read, in part:

> Haven't you always thought that your Microbee could be the very best machine ever…if only it had a proportional analogue joystick?...(hammer, hammer, hammer)…And if it had a parallel printer interface…well, it follows that you could hang a parallel printer off the side, doesn't it?... (bash, bash)…And that printer would really be earning its keep if you could somehow wire up a phase-locked loop decoder, a pitchpipe tuning aid and a shortwave receiver, to the Bee, so you could receive the signals that would let you print out weather maps…a bit of Clag should hold it…hmm…There must be room for a…um…ROM reader to plug in the back there somewhere…(59)

This treatment of the will to mod one's machine, for its own sake, whilst lighthearted, captures the irrepressible curiosity which seems to drive hobbyist tinkerers.

Reviewing archival material, one could be forgiven for thinking that the entire population of early computer users must have been technicians of some sort. Certainly, some had pre-existing expertise in electronics and associated areas, gained either through education or professional experience. Selwyn Arrow, for instance, was a technician with the New

Zealand Post Office. Nevertheless, "fiddling around" (Heemskerk) with electronics and computer innards was not limited to those with an existing knowledge of electronics, and it is this point that I particularly wish to focus upon. It was possible to acquire technical knowledge through personal study. Books and other published guides existed to help the novice teach themselves. The magazine *Electronics Australia*, for instance, published *Basic Electronics* in 1979, a soft cover "introduction to electronics". Its authors claimed that:

> When you have assimilated the information it contains, you will be in a good position to enlarge upon it by studying the other more comprehensive textbooks and by embarking on more advanced constructional projects, with the help of magazines such as "Electronics Australia" (Williams & Rowe, 1979, 2).

Another example of the published supports available to novices is John Heilborn's book *Commodore 128® Troubleshooting and Repair*, which catered to "both experienced and inexperienced users who want to repair their Commodore 128" (1988, ix). It assumed no knowledge apart from "that you are reasonably handy and that you want to fix your computer. I'll discuss the use of any tools you'll need as we come to them" (4). Heilborn's book is a how-to guide to help people tinker around with their computer's hardware. Amongst other things, it explains resisters, transistors, circuits etc, integrated circuits, clocks, has diagrams of the internal architecture of the 8502 chip, and locations of the 8502 and Z80 on the processor board. Other titles in the series, written by the same author, include *Microwave Oven Troubleshooting and Repair*, and *VCR Troubleshooting and Repair Guide*.

Would I be prepared to open up the back of a computer (or a microwave or VCR) with just a book for guidance? Whilst I consider myself "reasonably handy" (Heilborn) and prepared to give many things a try, I suspect I would not open up my electrical appliances, and I marvel at the apparent willingness of users of these times to get across the technical detail and do so. Our willingness to open up electrical appliances and attempt repairs (to say nothing of repurposing and modding appliances) has changed in the intervening years. Today, if users bother repairing electrical items, they are far more likely to want to leave such repairs to an expert, someone who knows what they're doing. Many contemporary users replace rather than repair electrical items: perhaps they wish to keep up with upgrade cycles; perhaps a product's design makes it (near) impossible to conduct repairs (Hertz and Parikka 2012). By contrast, repair and troubleshooting activities constituted the norm amongst electronics hobbyists (and no doubt others: think of car enthusiasts) at the time. In electronics, there was no shame in building something for curiosity's sake, and because it was a hobby, it was accepted that it would be fun; if something went wrong, the stakes weren't that high. Whilst some others struggled with the emergence of a tinkerer's ethic in early computer culture (eg. spouses[4]), the electronics community understood this mode of engagement with technology well and knew how enjoyable it could be.[5]

The 1980s user's involvement with electronics is remarkable not only for what people were prepared to do, but also because it is not better known. Amongst computing historians, mentions of early users' electronics nous and hardware hacking are scarce. Galloway is one of the few who mention users' expertise and backgrounds in fields such as ham radio (2011a, 2011b; Simon 2007; Saarikoski and Suominen 2009; Haddon 1988). That this does not receive more attention is surprising, given that electronics was obviously central to many people's engagement with computers and games at the time: a

number of local teenagers interviewed about their game developments professed desires to study electrical engineering (Filatoff 1983), and local technical writers who were active during the period continue to publish their amateur radio call signs in their biographies (Silicon Chip publications).[6] Yet the electronics and engineering connections in early microcomputing seems to have been all but forgotten.

CONTEMPORARY IMPLICATIONS

Games have a strong relation to both historical user-generated hard- and software production which warrants remembering. Why it has not been better remembered is beyond the scope of this paper. In what remains, I want to consider the significance of this historical user, in terms of how we think about users, today.

Recovering and reclaiming the lineage of early microcomputer users in coding and electronics is significant for game studies, particularly for histories of games. The period clearly provides a useful historical context for such contemporary gaming practices as overclocking, speedrunning, circuit bending (Franklin 2009), and case modding, connecting these with historical figures that make sense.

Moreover, accepting the early user as an antecedent to the contemporary user introduces a much-needed historicity to accounts of user productivity in general. That this is needed is evidenced by the historical amnesia of those who think that user productivity began with the age of broadband. Remembering the perspectives of those users – both 'gamers' and others – who fiddled and tinkered and hacked and modded provides an expanded historical account of use whose significance extends beyond the history of games.

The central role of electronics in the early micro period, in particular, reintroduces hitherto absent perspectives for the study of productive audiences. This is especially relevant for contemporary digital media studies' thinking about audience, where the intellectual traditions and currents have mostly come from fan, television and cultural studies. These are useful traditions, up to a point. However, it needs to be asked whether they provide the most appropriate ways in which to understand user practices, for example, of hardware and software creation and modification. At the very least, recovering the electronics competency of early users as another branch in the family tree of user studies might interrupt the smooth continuity that can seem to stretch, in some accounts, from engagement with film and television screens to engagement with computers (White 2006).

The engineering origins of early user productivity are overlooked in most discussions of productive audiences. Recovering traces of earlier cultures of user productivity allows a number of critical questions to be posed about user productivity in the present moment. In general, users of the long 1980s were much more 'hands on' than users today. Why was this, and what ought we to make of it? Judging from Arrow, some of the attention users initially focused on hardware may have been redirected into software and the question of putting computers to use by mid-decade. Reflecting on the change in computer club membership, he remarked:

> One of the inevitable changes over the years was the move from the original build-it-yourself type of member of the first few years, to the emphasis the club and its members now place on the use of personal computers, a swing from hardware orientation to software and its uses." (1985, 108)

More recently, others have observed that contemporary computers are effectively 'black boxed'. Bart Simon, for instance, reprises and critiques the design wisdom of Donald Norman, writing that "Users are, in an important sense, locked out of the technology for their own good (but, in fact, it is for the good of the existing military-industrial-political complex)" (2007, 178). Brogan Bunt has written on how difficult it is for artists to engage creatively with contemporary 3D Game Engines: working with these engines typically means having to accept the aesthetic and other assumptions which are built in (2006).

Such observations sit uneasily with claims about contemporary users' importance as participants and creators of digital culture in the Web 2.0 era, in which *Time* magazine famously named 'You' the Person of the Year for 2006 (van Dijck 2009).[7] Yet despite the rhetorical emphasis on the productivity of users, no one seriously argues that (many) users understand very much about how the contemporary computer-mediated social environments they are using for creation actually work. Another pertinent factor is that many of the activities of users today revolve around the creation and development of texts (blogs, wikis, Wikipedia, Twitter), aggregation activities, and the sharing of what are essentially documents and links (image and video on Facebook, Youtube, delicious). Textual production is a long way from engineering circuits. How much common ground does the Wikipedia editor share with the overclocker and the case modder? Do we infer that the user has been hollowed out over the ensuing decades, as the facility to tangle with electronics and software engineering has moved beyond the grasp of most? Perhaps this lack of ability to access and modify is a form of having to "make do", as in John Fiske's conception of an active audience, which as well as activity entails "an acceptance of the …boundaries of one's activities and a sense of a level of resignation and lament" (Marshall, 2004, 9-10)?

What has become of the will to mod today? Were the early days of microcomputing such truly remarkable times that they attracted an above-average quota of technically literate hobbyists and professionals, or might it be that today, there are fewer opportunities to learn these electronics and other skills? The emergence of make faires and boot camps facilitates the learning of some skills and the sharing of knowledge. They attempt to empower users to work once again in a 'hands on' way with computers, developing DIY projects. But these are comparatively small initiatives, of short duration, operating at the periphery. By contrast, today's users face significant challenges in penetrating the complexity and closed nature of much hardware and software. There's a reason why the open source community is where much software innovation occurs. When I begin to follow the instructions in Andrew "bunny" Huang's *Hacking the Xbox* or Simon Carless' *Gaming Hacks*, or decide to undertake an O'Reilly course or follow Lifehacker's detailed "Nightclass" set of instructions and Build my own PC, my situation is in some ways comparable to the 1980s novice who decides to open up the back of their Commodore with Heilborn's book as reference, and find out what computers are all about (Gordon 2011; Carless 2005; Huang 2003; Anon.). But it's also different. I am more limited in the extent to which I can get inside and poke around in what are today much more complex systems. A range of design decisions have been taken which limit my access. In addition, if I cook my computer, the stakes are higher: I rely upon it for my income-producing employment, as well as many other tasks in ways that the 1980s hobbyist did not.[8]

There has been a shift away from experimentation with hardware and software by everyday users today, compared to early microcomputer users. Some hobbyists, of

course, continue to tinker, learning to program and joining the open source community. Others will work on their own hardware projects, perhaps as a member of a Hackerspace or Fab Lab, where peers can help to solve problems, perhaps approximating some of the functions of 1980s user groups (Swalwell 2010). For the most part, however, experimental hardware practices tend to now be the domain of media artists, hackers, and critical engineers (Oliver, Savičić, and Vasiliev 2011; Hertz and Parikka 2012).

ENDNOTES

1 "Micros and microcomputer systems first appeared in advertisements in Australian electronics magazines in mid-1976" (Richardson 1985).

2 The only example I can nominate is in a story on New Zealand computer executives from Bits and Bytes magazine in 1987, which produced one abstainer, Peter Thompson of Data General who commented "Playing with computers in my free time is abhorrent to me – which is not the sort of thing I should admit when trying to sell computers." Whilst Thompson had just about mastered Pacman a couple of years previously, intriguingly he claimed at that moment to be "more into fence posts and other rural things in my spare time" (No author 1987).

3 For a detailed excavation of the other software that users wrote, see my "Questions of Microcomputers' Usefulness in 1980s Australia" (Swalwell forthcoming 2012).

4 In magazines, spouses are often said to express frustration and irritation at the time and money that a computer hobby required. Tom Moffat parodies this as follows:

> "So! You've done it again! You've gone out and bought yet another computer book. Just wait til you get home – "There you go, spending more money on that §†%¢*‡%'§* computer while the rest of us can't even afford a night at the movies any more." (Moffat)

5 Such an ethic was also in evidence in the naming of groups like the 'Brisbane PC1500 Bit Fiddlers Club' as well as in the advice of those who counselled users to take things apart to see how they worked.

6 The staff of the current Silicon Chip magazine, includes, for instance, Jim [Jamieson] Rowe VK2ZLO, Ross Tester VK2KRT, Mike Sheriff VK2YFK.

7 In an interesting literary treatment of the user-generation phenomenon, Steven Jones identifies gaming culture as a key source of the re-appropriative energies behind the development of a range of fan-like activities "apparent in 'Web 2.0' technology developments – podcasts, blogs, Wikipedia, Flickr, Google Maps, Facebook, social tagging, social software applications of all kinds, all with user-created or user-aggregated content" (Jones, 2008, 45). My response to this would be that in considering such user-created and -aggregated content, we need to think beyond the fan tradition of engaging with particular pre-formed texts, to look at people's engagements with media technologies themselves.

8 The Foundation behind the recently-launched Raspberry Pi computer, which retails for US$25, "want[s] to see it being used by kids all over the world to learn programming" (Raspberry Pi Foundation 2012). This is an interesting development, not least because of the extensive references to the era of early microcomputers.

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