From Drills to Laptops:

Designing Modern Childhood Imaginaries

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Abstract

We introduce two case studies that illuminate a particular way of conceptualizing childhood and technology: the East Bay Fixit Clinic and the One Laptop Per Child project. Both cases borrow ideologies of childhood from contemporary American culture and ideas of technological potential from computer cultures. The developers and organizers in these two groups ground the resulting narrative in their own childhood experiences and their desire to provide the same kinds of experiences to children today. We highlight some of the dimensions of this narrative as well as some of its limitations in appealing to, and re-creating, a particular kind of child that resembles the organizers themselves: technically-inclined, often oppositional, and often male. These cases highlight both the prevalence and limitations of using childhood ideologies in the design process by showing how these particular versions of childhood are enlisted to frame technological development and the social programs that promote it.

Keywords

design studies; technology and childhood; technology and education; OLPC; maker culture; hacker culture

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Introduction: Imagining Childhood, Technology, and Design

This paper explores the contested role of technology in childhood and the role of childhood, in turn, in technology development. While today's dominant narrative of technological protectionism, often discussed in the United States as the need to limit 'screen time,' projects technology as a *danger* to what is most valuable about childhood (Steiner-Adair and Barker 2013), various counter-narratives have emerged that pose technology as a *contributor* to intellectual exploration and creativity, proclaiming the potential for children to learn to use technology in transformative ways. These imaginaries, even when seemingly opposed, often share common conceptions of childhood as a period marked by intensive, even ecstatic, creativity, exploration, and play.

We interrogate two projects that share a common counter-narrative of childhood and technology grounded in computer engineering culture: the East Bay Fixit Clinic and the One Laptop Per Child (OLPC) project. We use ethnographic observations of the daily practices of hobbyist fixers and the 'Maker' community in the San Francisco Bay Area and archival research on the forty-year development of the ideas behind OLPC's 'Children's Machine.' Both projects are motivated by the same kinds of cultural ideals centered on articulating what it means to be a child and the forms of individualism, creativity, and empowerment technology is thought to provide for childhood.

This counter-narrative is put to work in these groups to make coherent the *technologically-precocious child* as a social imaginary, which in turn motivates their respective projects. Taylor (2003) describes a *social imaginary* as the system of meanings by which people actively 'imagine their social existence,' connecting to the 'deeper normative notions' behind it (p. 23). The kind of imaginary at play here is one focused on how people extrapolate from their own childhoods and the childhoods of others. In particular, we show how members of each group base their ideas of childhood, and of technology's role in it, on their own nostalgic childhood experiences, often treating these experiences as universals. In doing so, both groups are attempting to reproduce their own childhood experiences by designing the kind of childhood they hope to see in their beneficiaries: one that is full of pedagogical experiences involving technology that would engage clever, scientifically-inclined, often oppositional, and often male elementary or middle school students.

The imaginary of the technologically-precocious child works to reinforce certain identities and values that circulate within not only the two groups described here but across the professional computing community more generally, reflecting the way that 'childhood' is imagined and articulated through the design process in various academic-industrial settings. Identifying and exploring the cultural roots of this imaginary allows us to critically examine the relationship between the designer, the artifact/experience, and the kind of 'user' they aim to create. Through this, we chart how the imaginary of the technologically-precocious child emerges as part of day-to-day technosocial assemblages, and how it comes to have such power in the groups we studied and beyond.

In both cases, however, we observe a slippage between designers' conceptions of their 'users' and the users they actually reach. We use this to lay bare the larger cultural infrastructures that support and enable engineering communities through the material effects this imaginary can have, especially the paradox between the rhetoric of possibility and the unspoken limits the imaginary builds. This work highlights the moral responsibilities designers and technologists have for the communities they hope to reach.

Case One: The East Bay Fixit Clinic

Our first case study illustrates how the imaginary of the technologically-precocious child implicitly but repeatedly crops up in volunteer repair collectives, or what we term facilitated public sites for repair. We first examine the motivations behind these sites for repair, rooted in founders' own childhoods and ideals about childhood. Following one particular repair event, we then detail the slippages between these motivations and what actually occurred at the event. These slippages suggest certain blind spots the organizers have regarding who their events actually reach, what these participants gain from the experience, and what that means for their ideals of childhood and technology.

Public sites of repair exist as hobbyist engineering initiatives that help local residents fix broken things. Toasters that no longer heat or Bluetooth devices without a signal come to life again with the tightening of a screw or the heat of a soldering iron. Visitors gain assistance from a handful of tech-savvy volunteers (or 'coaches') who bring their own T-handle screwdriver sets and fine-tipped soldering irons. Since 2009, these repair collectives have popped up in cosmopolitan cities including New York, Amsterdam, Shenzhen, and San Francisco. Our case focuses on the East Bay Fixit Clinic, one such group that gathers at museums, libraries, schools and other public venues roughly once a month in the San Francisco Bay area. As part of a larger network of repair organizations (e.g., Repair Cafe, Fixers Collective, and Restart Project), the events bring together environmentalist ideals and collaborative work to rescue broken consumer electronics from the landfill and inspire people to learn technical repair skills in the process. Even as they focus on hands-on device-level repair, organizers frame their work as something more. They also use the events to perpetuate stories of childhood –

especially their own childhoods – that are meant to enable themselves and their participants to re-envision their roles in society.

Though children often remain marginal in these events, their participation nonetheless drives the organizers' ambitions toward transforming the world around them. To understand the transition from fixing, to childhood, to broader social change, consider the work of Peter Mui, a trained engineer, marketing specialist, and founder of the Fixit Clinic. Mui says he set up Fixit Clinics to enrich young minds by instilling in them a curiosity for electronic tinkering. For this reason, he was particularly keen to work at museums where he could target what he called his core demographic, the 'precocious middle-schooler.' Mui explained that this was 'the kid in the family who gets all the broken stuff, typically – who can be the hero if he or she can bring it and repair it. … So, you know, if the family's given up the toaster for the ghost and the precocious middle-schooler can bring it into Fixit Clinic and repair it.' Mui saw a child's interest in disassembling a device as a natural inclination, and the Fixit events as one way to support this technical predisposition.

This process of learning felt particularly familiar to Mui, who, before entering MIT at the age of 16, was already invested in an engineering education at home. Though he did not reference it more generally, in an interview with the second author he admitted,

> I *was* the precocious middle-schooler. When things broke in the family, I would get them… I would get them to take it apart and sometimes I would fix them and sometimes I wouldn't. I think my parents taught me to be resourceful. And my father particularly –

sort of doing goofy things with the train set, [showing me] it didn't have to be this way.

In this way, Mui saw the ambition he wished to bring out in his participants — a curiosity for how things work — as emblematic of his own childhood experience. Among his family members, Mui received the broken appliances and took a screwdriver to them to discover what was wrong. While disassembling train sets with his father, he explored possibilities for their reinvention. Mui admitted that he based his view of childhood education on his own experience in part because he had no children of his own. However, he saw this as more of an asset than a liability. 'I feel like my ability to contribute to the welfare of children is greater because I'm not raising my own kids,' he explained. Though he had wanted to have kids, his wife did not. This wish, left unfulfilled, came to inspire his efforts to raise children through an alternative pedagogical program that reproduced the childhood he knew.

As Mui conceived of his core demographic in own image, he did so with an eye toward what that image could be used to accomplish. Mui's sense that a technology 'didn't have to be *this way*,' and that he could transform it into something completely different, focused his concerns for childhood education on individual creative-technical confidence – with a purpose. He wanted children to lose their fears of opening up electronics in the hope that they might transform not only their own understandings of the technology, but also their role in enacting societal change. In his words, 'I really want to demystify science and technology. And my alternate surreptitious goal is that I'm hoping at some point we'll be able to make better policy choices as a society.' In this way, Mui wanted to encourage children's ability to fix things in order to shift how they framed their own technical competence, but hoped that this shift could also enable them to imagine alternative forms of consumption. By reframing their sense of agency in relation to everyday goods, children could build a better world around them. For his part, Mui saw electronic tinkering among children as the path to realizing broader social programs of environmentalism and technological progress.

Mui was not alone in building this agenda through hands-on engagements with technology. A self-described 'geek,' he embodied a philosophy shared by many participating in what the media have termed 'the maker movement.' The movement involves community-supported hobbyist exploration of electronics learning, typified by projects featured in the do-it-yourself (DIY) magazine *Make* and the DIY technology festival *Maker Faire*. Several of these projects come out of Maker Media, an independent for-profit organization run until early 2013 by the multinational computer manual publishing company O'Reilly Media, Inc. Maker Media founder Dale Dougherty also launched several education programs: *Young Makers*, bringing together 12-17 year olds with adult makers; *Makerspace*, introducing high school students to small-scale digital fabrication tools; and the *Maker Education Initiative*, building communities of young learners around making projects. An emphasis on children's creativity and hands-on learning through electronics tinkering underlies each of these projects. The Young Makers tagline is 'inspiring and developing the next generation of innovators' (http://youngmakers.org); the Makerspace website exhorts, 'We're building the infrastructure for more kids and adults to connect to a future in which they can personally change, modify or "hack" the physical world' (http://makerspace.com); and the Maker

Education Initiative aims ‘to create more opportunities for young people to make, and, by making, build confidence, foster creativity, and spark interest in science, technology, engineering, math, the arts – and learning as a whole’ (http://makered.org).

On January 9, 2013, Dougherty and Mui helped co-organize a Fixit Clinic at the Lawrence Hall of Science (LHS) in Berkeley as part of the Young Makers program. Five coaches showed up for the event, eager to give children ‘permission’ to take apart their broken electronic devices and find out why they were no longer working. Yet no more than two or three visitors participated at a time. At one point the ratio of coaches to participating visitors dwindled to four coaches per visitor’s device, often leaving the coaches with little to do.

Even more notable was who attended the Fixit Clinic that day. Despite the *Young Makers* affiliation and the museum’s family-friendly reputation, retired and elderly visitors populated the event. In fact, only one child participated in the Fixit Clinic. A young boy brought in his father’s broken electric drill, and then watched from the sidelines as the underutilized coaches dove into its repair. Not long after the boy joined the Clinic, the museum staff flooded the floor with a film crew to capture the child in action. Noting the lack of interaction between the boy and the coaches, an LHS staff member wanted the coaches to show the boy why it was hard to replace the battery on his drill and how to fix it. But, despite their commitment to reaching children, the coaches seemed uninterested in providing such direct lessons. Mui explained to the staff member, ‘All we can really do is instill a curiosity in the world around him. Next time he’s working with his dad and the battery goes dead, he knows as much as his dad.’ Mui saw curiosity as the path to learning how something was made, and avoided what he saw as didacticism. He overlooked the boy's passive engagements at the clinic to emphasize broader concerns for exposing children to electronics tinkering in the first place. Concrete learning outcomes came second.

Given the boy's ambiguous relation to the fix, the museum staff filming the event had to work hard to produce a coherent educational narrative. They peppered the boy with questions, captured him chatting with one of the coaches during a moment of diagnosis, and fed him talking points about what he learned from the event. In an edited video posted on the LHS site after the event, a clip of the Fixit Clinic showed only the boy's statements: 'If it wasn't for the Lawrence Hall of Science Fixit Clinic, this thing wouldn't be here but on the scrap heap,' he proudly declared while holding up his fixed drill. While the one child visiting in the clinic did not participate in the repair, his story was used to propagate the museum's vision of the child tinkerer learning through disassembly.

Despite the relative dearth of children at the Clinic, organizers nonetheless reinforced imagery of youth-driven engineering throughout the event. Just outside the Fixit Clinic room, a set of lectures highlighted local makers as part of the Young Makers event. Echoing Mui's broader motivations, the Google+ feed for the event on the LHS museum website proclaimed, 'Tinkering with things is a legitimate way to learn about the world.' Through the disassembly and reassembly of consumer products, organizers sought to emphasize not only the rewards of device-level tinkering, but also cultural expectations of childhood and educational reform. The hope was that if participants became *technically* empowered, they could go on to transform *social* structures as well.

Not part of the discussions that day, or among repair collectives more generally, was whether the prototypical child the organizers were targeting was really any child, or only a certain kind of child. Introducing the lectures as the first of their kind at the Lawrence Hall of Science, Pixar employee and organizer for the event Tony Derose explained:

> This program grew in part out of my family's experience. We've been making here [in our everyday lives] for as long as we can remember, but it really didn't crystallize for us until the first Maker Faire in 2007. And it was at that point that first of all we had a label for ourselves, and that was really powerful, and second, we realized that we weren't weird. Well, maybe we were weird, but at least there were a lot of other weird people.

Being 'weird' — and technologically competent — also entailed experiencing the world through children's eyes and borrowed from broader technological and educational narratives of what was part of 'natural' childhood development. Mui opined that 'fixing is a natural segue to making': as children disassembled devices they learned to play, dabble, and reinvent technologies and, accordingly, become more technically inclined – a virtuous cycle that built on natural inclinations. Dougherty, however, complicated the link between creative curiosity and technical cleverness as he described Derose's inspiration for the event to the second author in an interview, admitting, 'We have to always say that Tony's family is maybe a bit unusual in their fabrication skills and in the ambition of their projects.' While Dougherty acknowledged Derose's family's idiosyncrasy, doing so in terms of competencies and ambitions enabled Dougherty to highlight Mui's core demographic once again and cast membership in this demographic as a matter of choice instead of more systemic inclusion or exclusion, a theme we will expand upon in our discussion below.

The slippage between hoped-for and actual participants – and between coaches facilitating repairs versus just *doing* repairs – at the LHS Clinic was not unusual for these events overall. Organizers and coaches wanted children to participate in fixing devices in order to assume actively engaged roles in electronics and, in turn, society, even when they got caught up in the moment of fixing and sometimes did not include participants to the degree that they hoped. The figure of the precocious middle school student featured prominently across all of the Fixit Clinic's events and operations, and children's broken remote control cars and airplanes, though rarely actually present at Clinics, became pivotal symbols of the Clinic's ultimate challenge to encourage makers to remake the world. Though many visitors to the Clinic at LHS were retired and over the age of 60, the event's press materials included only children, and the sole child visitor was held up as emblematic of the movement's overall mission: to foster and enrich young minds, instilling in them a curiosity for electronic tinkering that, though generally unacknowledged as such, was reminiscent of the Clinic coaches' own childhood imaginaries.

Case Two: One Laptop Per Child

The narratives that those involved in these fixer collectives tell about childhood, and the role technology should play in it, are not unique to those communities. Indeed, they circulate throughout geek cultures in the United States and beyond, from Silicon Valley, California to MIT in Boston, the birthplace of the One Laptop Per Child (OLPC) project. In the next case study, OLPC made explicit some of the narratives about childhood that implicitly circulated at the Fixit Clinic, and even set them as design goals, often pitted against formal schooling. To show this process, we first interrogate OLPC's core ideas that the best learning is playful and self-directed outside school, and the best tool for learning is a computer like the ones OLPC's developers themselves used as children. We then discuss the specific conception of 'childhood' upon which OLPC rests, a conception that is Western, individualist, middle-class, and often male. However, as we saw in the Fixit Clinic, there were slippages between these ideals and the realities of use that complicated both OLPC's vision of childhood and the role technology should play in it.

OLPC's laptop, called the 'XO,' was the first of its kind to combine a rugged design, an open-source educational software suite, a mandate to minimize costs, and full (though purposefully underpowered, in an attempt to prolong battery life) computer functionality, with the goal of overhauling education across the Global South. The project is a culmination of over forty years of work at the MIT Media Lab and its predecessors, particularly the intellectual legacies of MIT professors Seymour Papert and Nicholas Negroponte, both of which are centered on Papert's learning theory, *constructionism*.[3] In the early days of the project, OLPC's leadership often avowed the project's roots in

[3] Despite the similar name, Seymour Papert's 'constructionism' is distinct from social constructionist theories in the social sciences.

constructionist learning, reflected in the project's Mission Statement: 'XO embodies the theories of constructionism first developed by MIT Media Lab Professor Seymour Papert in the 1960s' (http://laptop.org/en/vision/mission).[4]

Constructionism, as described by Papert in books, articles, interviews, and other statements between 1971 and 2006, aims to leverage children's natural desires to tinker with and make sense of the world by giving them an 'object-to-think-with' that inspires self-motivated mathematical learning (Papert, 1980, 1993; see also http://www.papert.org/works.html). Construct*ion*ism is based on (and often confused with) Piaget's theory of construct*iv*ism, but several aspects distinguish constructionist learning, such as the use of an 'object-to-think-with' (particularly a computer), a specific focus on the process of 'debugging' one's reasoning, and a focus on finding and developing passion in learning.

In his writing, Papert often contrasts constructionism with what he calls 'instructionism,' or the lecture-heavy, curriculum-based education that many schools pursue. Valorizing the former and villainizing the latter, Papert argues that instructionism creates 'schoolers' – people 'schooled' to think in certain limited ways, who seek answers and validation from others – out of 'yearners,' which he argues represents the innate, creative, playful state of children, rather than a different set of learned behaviors. In Papert's view, 'yearners' think independently, do not care what others think, and seek answers via many routes for questions in which they are personally interested (Papert,

[4] Constructionism has also had a powerful legacy beyond OLPC: it is regularly cited in research on 'unschooling/deschooling' (e.g. Selwyn, 2010) and 'lifelong kindergarten' (e.g. Resnick, 1998), has migrated into curricula on design and human-computer interaction, and is featured at conferences focused on technology in education such as Digital Media and Learning (DML) and Interaction Design and Children (IDC). One of its first test cases, the LOGO programming language, was tried nationwide in the 1980s and has been tested in other settings. Though the results of these trials were lackluster at best (Pea, 1987; Shea & Koschmann, 1997), constructionism remains popular.

1993). Papert is unequivocal about his disdain for the ‘instructionist’ model of education, calling the classroom ‘an artificial and inefficient learning environment’ (Papert, 1980, pp. 8–9) with no value, its purpose molding children out of their natural state and into a more socially ‘desirable’ form:

> School has an inherent tendency to infantilize children by placing them in a position of having to do as they are told, to occupy themselves with work dictated by someone else and that, moreover, has no intrinsic value – school-work is done only because the designer of a curriculum decided that doing the work would shape the doer in a desirable form. (Papert, 1993, p. 24)

With the exception of a few brave teachers who fight against the establishment (Papert, 1993, p. 3), Papert’s description of a monolithic ‘School’ (always capitalized) is of an institution unchanged for over a century, ‘out of touch with contemporary life,’ and shamelessly ‘impos[ing] a single way of knowing on everyone’ (Papert, 1993, pp. 1–6). As an alternative, Papert proposes giving each child a ‘Knowledge Machine,’ a clear forerunner to OLPC’s XO laptop. He wants the resulting frustration with how boring ‘School’ is in contrast to the machine to create a ‘market pressure’ for change in spite of the recalcitrant ‘schoolers’ (Papert, 1993, pp. 8–9, 12–13). Papert hopes that giving children their own computers could make education ‘more of a private act,’ one where each child can decide which aspects of education to adopt and which to discard (Papert, 1980, p. 37).

Why should a computer, in particular, be the solution to problems with school? Even though Papert and Negroponte both grew up before the era of personal computers, they write about the joy of encountering MIT's mainframes, and the nascent computer culture around them, when they joined MIT as professors in the late 1960s. Both rhapsodize about the 'holding power' that these computers had for them, and Papert credits these formative experiences as inspiration for the Knowledge Machine. 'I realized that children might be able to enjoy the same advantages' as the early MIT hackers who he befriended at those mainframes, Papert explains in *The Children's Machine* – 'a thought that changed my life' (Papert, 1993, p. 13).

Papert readily and repeatedly admits that much of constructionism was similarly inspired by personal experiences, and describes his own process of 'unlearning' in several of his books. He explains that while he grew up before computers were common, his early obsession with gears as an 'object-to-think-with' provided a framework for mathematical learning that school did not, and later inspired his theories about the importance of such objects. *'I fell in love with the gears,'* Papert explains in his 1980 book *Mindstorms* (p. viii, italics in original). While he acknowledges that gears in particular may not appeal to all, he follows by saying computers could be a much more universal 'gear' for learning mathematical thinking:

> My thesis could be summarized as: What the gears cannot do the computer might. The computer is the Proteus of machines. Its essence is its universality, its power to simulate. Because it can take on a thousand forms and can serve a thousand functions, it can appeal to a thousand

> tastes. This book is the result of my own attempts over the past decade to turn computers into instruments flexible enough so that many children can each create for themselves something like what gears were for me. (Papert, 1980, p. viii)

Papert further claims that by elementary school, with the help of gears as an object-to-think-with, he already knew that his ‘best intellectual work was done outside the classroom’ (Papert, 1993, p. 23). In his words, ‘playing with gears became a favorite pastime. … I believe that working with differentials did more for my mathematical development than anything I was taught in elementary school.’ (Papert, 1980, p. vi)

Papert is not alone in the expressing scorn for traditional education and rhapsodizing about computers in its place. Many of OLPC’s contributors, whether affiliated with MIT (including professors) or the open-source community, describe similar sentiments. For example, OLPC founder Nicholas Negroponte, who also founded the MIT Media Lab in 1985 and directed it for the next fifteen years, proudly describes being dyslexic and hating to read in his techno-utopian book *Being Digital* (Negroponte, 1996). Negroponte has also said that he actively encourages students to throw off the yoke of conventional ‘schooled’ thinking and draw on their childhood experiences as inspiration in their research (Negroponte, 1996, pp. 200–204, 219–223, 1998).

Even though not all people in the OLPC community actually rejected school (and many, in fact, excelled, securing entry and even professorships at high-status universities like MIT), they share narratives about how boring, stifling, and unfulfilling classroom education was in contrast to learning about computers, which they describe as something they did on their own, driven by feelings of passion and freedom, and independent of any formal instruction. Indeed, programming is one of few high-status, high-paying professions where one can go far without even a high-school degree, and OLPC's development team was no exception. Christopher Blizzard, the Software Team Lead for OLPC through spring 2007, has written proudly on his blog about being a high-school dropout who later earned his G.E.D. and is now a well-respected open-source developer (Hempel, 1999). Ben 'Mako' Hill, a longtime advisor to OLPC with a PhD from the MIT Media Lab, describes with great candor his educational journey through ADD diagnosis, Ritalin, and various public and private schools in an online essay titled 'The Geek Shall Inherit the Earth: My Story of Unlearning.' He wrote about how strongly he identified with 'The Hacker Manifesto,' first published as 'The Conscience of a Hacker' in 1986 in the hacker magazine *Phrack* (Thomas, 2002), when he encountered it as a disenfranchised teen. In his essay, he mimicked its fierce and antagonistic, yet also eloquent, description of the alienation of school and the camaraderie of the computer, also (quite possibly intentionally) using some of the same language as Papert about 'molding' children versus letting them develop freely.

> By day, I felt school forcing me into a rigid and uncomfortable mold – often resorting to chemical means to accomplish the feat. By night, I was able to learn, build, explore, create, and expand myself, both socially and educationally – an ability only afforded to me through my use of technology. (Hill, 2002)

In describing constructionism, Papert sets up himself and others like him – and like Chris Blizzard, Ben 'Mako' Hill, and Nicholas Negroponte – as exceptions to the 'schooler' paradigm. Some adults have been able to resist the 'infantilizing' effects of instructionism and remain 'yearners,' Papert says, including independent thinkers, lifelong learners, and, it turns out, many in the hacker community. However, as we also saw among Fixit Clinic staff and will discuss in more detail below, neither Negroponte nor Papert discuss the possibility that they enjoyed privileged and quite likely idiosyncratic childhoods, nor do they dwell on the sociotechnical infrastructure that enabled their privilege. If anything, Papert's accounts of using constructionism in classrooms or other settings (e.g. see Papert, 1980, 1993) reinforce notions of exceptionalism by focusing exclusively on the few engaged children, those rare emblems of 'success' who appear to prove one's theories, and ignoring the rest.

OLPC's idea of the self-taught learner who disdains school for computers discounts the critical role that various institutions – including peers, families, schools, and communities – play in shaping a child's educational motivation and technological practices. Instead, Papert and other OLPC developers both essentialize the child-learner and make the child and the laptop the primary agents in this technosocial assemblage, favoring technological determinism – all it takes is the right kind of computer to keep kids as 'yearners' – over the complicated social processes involved in constructing and negotiating childhood.

The Imaginary of the Creative, Rebellious Child

As we have seen, the Fixit Clinic and One Laptop Per Child both explicitly stated and implicitly built into their projects the idea that children are born curious and only need a small impetus (such as a computer or an electronics kit) to keep that curiosity alive and growing. While this narrative is not unique to these communities, the imaginaries of childhood at play here have de-emphasized the cultural and social basis of children's curiosity and learning, instead claiming or implying that these traits are innate. They also go one step further to specify the *kinds* of learning that children are naturally inclined to do. At the Fixit Clinic, Mui points to young makers as his core demographic despite their scarcity at the Clinic's meetings, lauding and identifying with their natural curiosity and, in the process, defining 'curiosity' around initiative and certain kinds of technical orientations. Similarly, in glossing over the many complexities of childhood with universalizing concepts like 'yearners' and 'schoolers,' Papert draws on narratives about what childhood should mean and what constitutes a good one, based on imaginaries of childhood that are deeply rooted in a version of American culture and reflect American cultural values such as individualism and (certain kinds of) creativity.

These narratives draw on broader imaginaries of childhood focused on the natural curiosity, brilliance, and rebellious nature of children. Though seemingly pervasive, these imaginaries are historically, geographically, and socioeconomically situated. Most trace their roots to 19^{th} century reforms and ideological shifts in the United States and western Europe that redefined childhood as a developmental stage distinct from adulthood: more noble, more creative, and closer to nature (Chudacoff, 2007; Mintz, 2004; Zornado, 2001). During the 20^{th} century in the United States, they spread beyond the upper classes to become institutionalized in mainstream middle-class parenting culture (Chudacoff, 2007; Zornado, 2001), focusing on individualized creativity in particular. Amy Ogata (2013) argues that the notion of ‘everyday creativity,’ for example, is rooted in prosperous conditions of post-WWII America in which the culture among middle class and largely white families emphasized spending time and money on what they identified as children’s intellectual and creative ‘needs,’ including more personal space, more opportunities for play, and an unprecedented number of books, toys, and other personal belongings. As a result, parents embraced toys that promised to boost IQs, schools that embodied progressive ideals, and private playrooms that encouraged individualistic creative play.

Like individualism and creativity, a certain degree of ‘healthy rebellion’ has also become an accepted part of American youth culture, especially for boys (Mintz, 2004; Mosco, 2005; Oldenziel, 2008). Far from the more ideologically intimidating rebellion that takes on racial or socioeconomic overtones or threatens to actually change the status quo, the kind of rebellion that is sanctioned in the white, middle-class, masculine childhoods that largely populate the imaginary at work here is often tolerated as ‘boys will be boys’ or even encouraged as free-thinking individualism. From Mark Twain’s *Tom Sawyer* to today, popular culture has linked relatively harmless forms of rebellion against school and society with creative confidence, driven by naturally oppositional masculine sensibilities. Similarly, the groups in both of our case studies embrace oppositional attitudes as natural and good. Constructionism and OLPC assert that the kind of learning they advocate may well fly in the face of the kinds of learning that teachers, parents, or other adults may want, but such resistance should be encouraged as the expressions of ‘yearners’ against traditional schooling. Mui and other Fixit coaches likewise frame the clinic's repair activities as a form of rebellion against consumer culture more generally.

Finally, the *masculine* aspect of this rebellion plays an important, though often unstated, role in the broader imaginary of childhood at play in the groups we studied. Just as feminist and queer scholars have shown that the category of 'male' is often regarded as default against which 'female' is the Other or absent entirely (Butler, 1990, ch. 1), the category of 'boy' is what the unmarked signifier 'child' often represents, while 'girl' is specifically marked and set apart. This is to some extent reflected in both the Fixit Clinic's promotional materials and Papert's writings on constructionism, which are both peppered with examples of precocious *boys* enthusiastically taking up their causes. While neither group specifically excludes girls – both would, in fact, welcome their participation, include occasional examples of girls, and speak in general terms about 'children' – their inclusion of both technological prowess and rebellion as integral aspects of their missions signal that boys are a 'natural' fit while girls would be implicitly marked as 'exceptional' and would need to account for themselves (Oldenziel 2008). The overwhelming presence of men in the leadership of both organizations does little to challenge these masculine defaults.

What is the role of technology in this creative, individualistic, rebellious, and masculine childhood imaginary? On the one hand, recent discourses around media technologies and childhood highlight the fragility of childhood in the face of an onslaught of child-directed marketing, passive consumption, violent/sexualized media, and facile devices (e.g. Steiner-Adair & Barker 2013). On the other hand, technical toys have defined American boyhood in particular for nearly a century, and in many cases have been lauded for supporting the natural inclinations of their target audience to tinker and explore. Technical communities like those featured in the two cases above align themselves with the latter discourses, asserting that technology can indeed foster creativity, competence, and even healthy rebellion in children.

Our case studies link childhood creativity, technology, and masculinity, focusing on the importance of masculine rebellion in the imaginary of the *technologically-precocious child*. We find that leaders at the Fixit Clinic and OLPC have generalized from their experience with largely white, middle-class American youth – as well as from their own idiosyncratic childhoods – that all, most, or at least the most 'intellectually interesting' (Papert, 1993, pp. 44, 50) children are innately drawn to tinkering with computers and electronics, or in Papert's words, 'thinking like a machine' (Papert, 1980). We conclude that rather than appealing to the 'natural' state of all children, the Fixit Clinic and OLPC are actually quite specific about the kind of child – and the kind of technology – that fit their visions for changing the world.

The idea of children, especially boys, being naturally enamored with technology travels beyond the communities we studied, and beyond computing cultures as well. Indeed, many who have watched a child with a touchscreen or a videogame have marveled at the holding power the device seems to have, and stories abound of precocious boys who seem to take to electronics fearlessly and naturally (Negroponte, 1996; Papert, 1980, 1993). Oldenziel (2008), among others, has argued that this latter proclivity is due to a century of targeted marketing toward boys in particular (with a few, mostly recent, exceptions). Oldenziel and other researchers have demonstrated that historically, toy manufacturers offered construction materials and electronics kits that appealed to parents' idealizations of innate masculine childhood play and imagination and their pedagogical goals for channeling these traits toward 'productive' ends, and established early the idea that engineering is a space for masculine creativity (Chudacoff, 2007; Douglas, 2004; Ogata, 2013; Oldenziel, 2008). While many of these toys echoed adult roles and were seen by adults as a way to socialize children into future career paths, they claimed to do so through the natural inclinations that boys had toward certain kinds of play, even though those patterns of play were relatively new and far from universal (Chudacoff, 2007).

Just as imaginaries of *play* influenced childhood/boyhood access to technology, related imaginaries about the role of *rebellion* in boyhood influenced not only what kinds of behavior adults tolerated or even encouraged in (especially white, male) children, but what toys and technologies that they made available. While rebellion and electronics tinkering may not seem related, the connection between rebellion and computing cultures is deep and well-established, particularly as countercultural norms of the 1960s were embraced by early cyberculture communities (Turner 2006). Narratives about the kinds of 'all in good fun' rebellion that computers could enable were popularized with the establishment of the 'hacker' identity through 1980s nonfiction books like *Hackers: Heroes of the Computer Revolution* by Steven Levy (1984), novels like *Neuromancer* by William Gibson (1984), and movies like *War Games* (1983), all of which occurred during the childhoods or early adulthoods of many of those involved with the two groups we studied. The importance of rebellion in hacker culture may also be a response to the rising fears in popular culture of technology curtailing the very same traits of childhood that hacker culture claims it can promote.

We found the imaginary of programming computers or hacking electronics as a mode of masculine rebellion – whether against school, peers, or societal norms – also common among Fixit Clinic organizers and OLPC's developers. They framed these ideas as stories of individual heroics, like Papert's 'yearner' child who voraciously engaged with a computer to avoid becoming a 'schooler.' In *Unlocking the Clubhouse* (2003), authors Margolis and Fisher link this narrative to American male computer scientists in particular. They note that the American-born men in the Carnegie Mellon computer science program they studied tended to both attribute their success with computers to their innate abilities and to tell stories about teaching themselves programming at an early age. Women and those in minority groups, in contrast, were more mindful of what they owed to those around them for their privileged position and also tended to discover computer science later.

In conversations with Fixit Clinic coaches, OLPC developers, and those who identify as 'hackers' across Silicon Valley and in Boston, we, too, often encountered the story of 'teaching myself to program' – even among some, like Mui, who also told stories of his father's tinkering. But we dug deeper into how this self-learning worked, and how their parents might have enabled their early access which, in turn, enabled their later success in engineering or computer programming. Like Margolis and Fisher, we found that in all cases those we interviewed benefited from an often-unacknowledged environment, including middle-class resources and cultural expectations and usually (though not always) a father who was a computer programmer or engineer. These boys were encouraged to try programming and had resources such as the programming exercises in *Scientific American* magazines or Commodore 64 manuals. Then, they often encountered other computer-savvy ‘outcasts’ in school or (like Mako) online, learning further from one another.

Moreover, many also acknowledged, sometimes readily, that they were not typical among their peers in their youth, and were often shunned for their unusual interests or obsessions. Even among their peers who had computers at home they were often unique, interested in learning to ‘think like a machine,’ as constructionism encourages, while many others with the same kind of access were not captivated by computers in the same way. This disconnect between the narrative of personal idiosyncrasy/rebellion common in computing cultures and the missions of the two projects featured in our case studies to change the world may seem incommensurate: how could these projects expect to change the world if the kind of child they are trying to reach is in their own rare, culturally-bounded, and idiosyncratic image?

These projects may also be limited by the type of technology to which they attributed their success. The 8-bit computers, game consoles, and online Usenet or BBS groups of the 1980s and early 1990s, which ‘hackers’ like Mako lauded as helping them discover ‘radical individualism,’ distributed communities of like-minded souls, and other ideals of 1980s hacker culture (Levy, 1984, Thomas, 2002, Turner, 2006), have given way to people’s present mainstream use of computers for media consumption. Today’s computers are more often connecting children to the music, videos, and games of transnational media conglomerates such as Nestle and Nintendo (Ames, 2013, ch. 3). This shift echoes the path that other technologies, from radio to cable television, have taken as early technological idealism made way for consumer-oriented realities (Mosco, 2005). Thus, not only were the architects behind the Fixit Clinic and OLPC misattributing their own childhood interests and eventual success, but they did not acknowledge that the machines of their youth no longer exist.

Designing the Technical Child

Given the disconnect between the nostalgized childhoods of those in the communities we studied and most children, as well as between the machines they grew up with and the machines of today, why would the designers of the Fixit Clinic or OLPC believe that their personal experiences would generalize to entire populations of children in Silicon Valley or across the Global South? Could it be that they recognized that only a few children would likely be reached, and though they did not publicize this, quietly believed it based on their own experiences? Or perhaps their object was more normative – to create, or 'design,' the kind of child they wanted to see in the world, even though their language was not one of production. Either way, the rhetoric that naturalized their missions as simply bringing out what was already innate in children as a way, whether conscious or not, masked their intentions.

In either case, when it came to the role 'users' play in the two communities we have discussed, we find conflicting narratives of design and use. Those who orchestrated Fixit Clinic events and built XO laptops shared ideologies of childhood and technology that may have differed from the interests of the people who actively participated in the projects. They asserted that engineering was an extension of their own childhood experience, and even as they claimed to want to engage all children, they fell back on their own skills, interests, and past experiences to generate guiding rubrics for their technological projects. These actions mirror the virtual city design practices studied by

Oudshoorn, Rommes, and Stienstra (2004). Whilst attempting to design for 'everybody,' the predominantly male designers in our groups and among those the Oudshoorn et al. studied configured their users in their own image, using the 'I-methodology.' They inscribed their own tastes, competencies, and views of gender identity – and in our examples, their own childhood imaginaries – into their designs to produce what Oudshoorn, Rommes, and Stienstra have termed a 'masculine design style' characterized by the designers' own interests.

This reliance on personal experience underscores an ideological slippage between the constructionist ideas taken up by the Fixit Clinic organizers and XO laptop designers and children's activities on the ground. Mui and his coaches aimed to provide children with more playful, independent, and technical learning environments. Yet, like the young male Fixit Clinic participant who brought in his father's drill, the children who came to the clinic tended to play a marginal role in the repair work. Instead, the coaches 'scripted' the repair of the one child-visitor at the clinic to be a successful one, much like the engineers that Woolgar (1991) studied scripted users' access to the machine through cases and user manuals, reasserting their own expertise in the process. Then, the museum staff further scripted the event by first ignoring older visitors and then casting the one child visitor as a more active participant in the repair than he actually was in order to fit the expectations of the event, again as Woolgar's engineers scripted who was a 'proper' user in the first place. While the Clinic's actions did little to reach more children or include them more actively in repairs, it nonetheless reasserted the importance of the imaginary of the technically-precocious child as central to its mission.

Similarly, XO designers aimed to provide access to pedagogical materials with the assumption that children's interests would take care of the rest. However, they did not account for their own idiosyncratic childhoods, the social and infrastructural assistance they received in learning about computers, or shifts in the meaning of computers, which meant that they ultimately reinforced existing socioeconomic and gender inequalities (Ames, 2013, ch. 3). In polarizing talk of 'yearners' and 'schoolers,' the project entirely left out many potential users, from teachers to children with diverse interests or lacking the requisite technical chutzpah, and a range of potential uses, focusing on technical interest and ascribing it as innate. As Madeline Akrich describes (1992) in reference to technology development, in producing an event, the organizers not only 'design' idealized technologies but idealized *social worlds*, assuming a particular set of competencies and possible social changes and 'inscribing' these expectations into the technology itself. Thus, their reliance on personal experience also enabled OLPC's naturalized images of childhood to justify a particular set of normative social objectives.

For these reasons, we have argued that it is morally critical to recognize the alignments and disconnects between childhood imaginaries and the practices they configure. Set in motion by a shared set of cultural ideals defining what it means to be a child, the forms of individualism, creativity, and empowerment discussed in this paper configure technology as a site for rethinking childhood and childhood as a site for empowerment through technology. What seem like purely technical resources – e.g., access to technically savvy engineers or a carefully-designed computer – are in fact social and political in nature. They are embedded in histories of learning and childhood that constitute much of how we envision technological development today.

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