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Cr/Hacking the (Gendered) System: Breaking Down Barriers to Women's Empowerment in STEM: A Manifesto

Teresa Pierce

University of Ontario Institute of Technology, teresa.pierce@uoit.ca

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It is time to stop relying on passive attempts to assimilate women and other diverse groups into the STEM fields. I believe now is the time to take action and reignite the spark of suffrage to accelerate institutional and cultural changes in the STEM fields that provide not just equal opportunities, but break down the doors that lock us out. Corporate diversity reports, online rape threats, and revenge porn attacks are frequently media headlines. But as technology becomes a more ubiquitous feature of modern society, we must ask who controls this technology now and in the future. Gender and its counterpart diversity are two of the most obvious delimiters because they both earn a "reform or else" reprimand in mainstream media. I draw from my radical roots to urge action that transcends public policy and initiatives for gender and diversity inclusion. Inclusion is a weak metaphor. We need a revolution. To paraphrase Star and Strauss (1999), there is a crack in the male-dominated technological infrastructure, so the time is right for iNfIl7R@ti0n, dI\$rUp7ti0n, and eNG@G3Ment that cr/hacks open the (gendered) systems.

Historical Roots

Since the 1960's the percentage of women in mainstream computer professions has declined. It was considered a crisis when only 30% of software engineers were female. Yet recent studies of open source engineering found, for example, that only about 4% of software engineers are female (Burnett et al., 2010; Chinn & VanDeGrift, 2008; Ghosh, Glott, Krieger, & Robles, 2002; Misa, 2010; Nørskov & Rask, 2011; Xu & Jones, 2010). Even as some groups are trying to encourage more women to enter the profession, increasingly violent modes of sexual harassment (threats of violence and sexual assault) work to keep women out. (Geek Feminism Wiki (2015); Nafus, 2012). For example, the fury and attacks in early 2014 fired at Anita Sarkeesian included rape and death threats (dubbed "Gamergate"). These events produced a flurry of media attention. While these experiences made headlines, what is not headline material is the fact that women are deserting mainstream software engineering. We are still coding, and we are uniquely positioned to break the circuits of gender disparity in more conventional (read male-dominated) STEM fields. But to do so, we must fortify the weak metaphors of inclusion and pipelines with stronger revolutionary metaphors.

The mainstream approach is to cite the success of any one of dozens of initiatives to get girls interested in programming (Kanny, M. A., Sax, L. J., & Riggers-Piehl, T. A., 2014). My approach is not that kind of wishful thinking. I am more concerned with the meaning of work in

the STEM fields, now and in the future. Those who are driving those changes and staying in the headlines - people like Richard Stallman, Aaron Swartz, Julian Assange, Edward Snowden, and Kim Dotcom - are all men. Women working for positive changes in the coding industry – people like Anita Sarkeesian, Joanna Rutkowska, Adeanna Cooke, and Raven Adler make headlines but for very different reasons. Adler is especially outspoken and was the first woman to deliver a technical presentation at DefCon. She is adamant about not being labeled as a "girl hacker," but popular media still objectify her. For example, a reporter asked Adler to pose in the pool in her bathing suit at DefCon and asked her questions like "Should a girl hacker date a boy hacker?". In an interview with InfoSecNews, Adler said that question about dating "left a bad taste in my mouth, too. Nobody asks the guys this stuff and finding myself a 'boy hacker' is not really tops on my list of things to do this weekend" (Gray, 2004). Even these remarkable women are not as well known as Snowden or Assange. Those who did make the headlines (i.e., Sarkeesian and Gamergate and "the hacker fairy" Cooke) did so because they experienced very public sexual harassment and confronted their attackers. But the problem lies in the media cycle. We are failing to push our ways into the headlines and keeping the media hype focused on us.

I pay tribute to Rossi's (1964) challenge by rallying to increase diversity in software development and envision a world that goes beyond inclusion to accurately represent the world in which we live. Over forty years ago Epstein (1971) analyzed women's participation in prestigious professional careers such as accounting, medicine, the biological sciences, business, judiciary and law, and engineering. She questioned the gendered distinctions that restricted women's participation in these professions. What are we waiting for? Why didn't Epstein's and Rossi's observations revolutionize the key issues of socialization, institutional structures, and organizational cultures, stereotyping, sex typing, and occupational value based on sex? Why aren't we using these forms of social control and self-perpetuating processes based on (bad) behaviors to expose and eliminate damaging cultural practices within the technology sector? Epstein's optimistic predictions of increased visibility that equate to increased possibilities and ideological changes for women and men is not the world we live in today. Forty years after Epstein predicted a world where "the gatekeepers of the traditional occupations will be forced to admit many who qualify professionally" (p. 203), women and minorities are still underrepresented in these careers. The rise of a technology-driven economy adds a new dimension to the issue. Star and Strauss (1999), in their examination of the ecology of work, suggested that to reveal an invisible

infrastructure we must look for the breaks in the visible infrastructure. These cracks expose the deliberately hidden ecosystems of the STEM fields' infrastructure. Gender inequity is the crack in the system that we must exploit and revolutionize these fields.

Long before anyone conceived of open source software, computer programming was a skill closer to typing and data entry. Consequently, it was heavily marketed to women as a career. Yet men still dominated the higher-level management positions. As computers and software gained importance to the economy, careers in software engineering gained power, status, income, and men (Ensmenger, 2010; Haigh, 2010). Before long, the industry reached a stable state where only 30% of computer programmers were women (Coder, Rosenbloom, Ash, & Dupont, 2009). Hayes (2010) referred to this as "the incredible shrinking woman." Hayes claimed that there were many initiatives to address this imbalance and most failed. Wacjman's (2010) understood that technology imprints as masculine. She also noted that the increased significance of the "elite engineer" with exclusive rights to technology through male identity, professional status, educational qualifications, and managerial promise contributes to the idea that technoscience is a masculine culture. Turkle (1984) identified this in hacker culture. Turkle wrote, "though hackers would deny that theirs is a macho culture, the preoccupation with winning and subjecting oneself to increasingly violent tests make their world peculiarly male in spirit, peculiarly unfriendly to women" (p. 216). At the time Turkle made this observation, the hacker culture was all male. Today female hackers/coders are actively contributing to the processes that shape our world. Technology is neither inherently patriarchal nor "unambiguously liberating" (Wacjman, 2010, 148). Gender and cultural differences are integral to innovation and understanding this, Wacjman argued, can be an inclusionary space where diverse populations flourish. I understand that not everyone wishes to become a hacker or software developer. However, I also understand that the opportunities for diverse populations in STEM and STS related fields face many of the same restrictions as the developer professionals and hackers.

Transformation or Revolution?

Computer technology and the internet drive our digital media economy. Media was big business long before the internet, but the internet and mobile technology facilitated the creation of new technology-centered online cultures. Watching and recording videos, playing computer games, listening to music, watching TV, shopping, talking on the phone, texting, taking pictures,

reading books, writing stories are all aspects of this business. The internet transformed the work environment. Working from home was widely accepted. Flexible hours became the expectation. Freedom from the conventional office promised the possibility for solutions to long-standing complications such as work-life balance, sexual harassment, and discrimination. But the internet work culture did not revolutionize our lives. Research revealed that these “freedoms” had no lasting positive affect on gender equity and diversity. Many studies found that gender disparity increased even further to where today the typical open-source software team, for example, is 96% male (Burnett et al., 2010; Chinn & VanDeGrift, 2008; Misa, 2010; Nørskov & Rask, 2011; Xu & Jones, 2010). As Hayes (2010) pointed out, outreach programs, such as the pipeline initiatives that emerged in the 1980's, attempted to increase the participation of women, but have not had a significant impact (Dunbar-Hester & Coleman, 2012). Why are we still privileging a weak, flawed metaphor (Husu, 2001)? Why are passive "solutions" such as Lin's (2005) suggestion that women take up supporting roles in open source, which go beyond programming when these supporting roles come with less power and prestige than programming? But Lin's ideas may be useful because open-source is a key factor in the development of the modern information infrastructure. The open-source wars of the 1990s between the Free Software Foundation and proponents of proprietary software are over (Kanellos, 2005). This was a sweeping victory for open source (Ebert, 2007; Ven, Verelst, & Mannaert, 2008). Expertise in repository services for source code management like Pastebin, GitHub, and StackExchange can now substitute for a university education and experience, and this has the potential for revolutionizing the STEM industries. But this must be done without producing a free labour system that Terranova (2000) identified as NetSlavery (p. 33). But many proponents of open source software had a political and emotional attachment to the promise of free information. Only a few asked what kind of world free information would create. Even fewer dared to answer, and they were women. In 2004, Robin Mansell wrote, "Rather than addressing issues of unequal participation and power in the open source communities of practice, for the most part, the presence of an all-pervasive, gift-giving, reciprocal, non-hierarchical economy and culture is assumed" (p. 101). Today open source software is even more prevalent, and a technological and political utopia for both capitalists and Marxists alike.

Women are as active as men in most internet social media, but we are virtually non-existent on sites focused primarily on programming (pingdom, 2012). This must not continue. We must cr/hack the system and knock down the gender barriers. Critical feminist scholars like myself are

concerned about the types of politics that a male majority imbues on the technology they create. Too often, the technological gender imbalance is presented as a problem with women, not with the technology or the culture that supports it. Men are not the only ones with this attitude. As Micky Lee (2006) wrote, "Women's own discourses of technologies that are characterized with words such as "obstacles" or "difficulties" should be questioned ..." (p. 202). In other words, it is not a woman problem, it is a perception problem that women face, but men do not. Free labor has played out very differently in the software development world, and there are more producers of content than consumers. End users are consuming a corporate product. It is the software corporations who profit from the free labor product. For example, fan fiction began as a leisure activity that book publishing companies leveraged into paid work and sold to mass markets. Software development started as a professional activity that software publishing companies leveraged into free labor that sustains an advertising or service market. What both communities share is a leisure source of talent and mythology. Both fiction and software require writing talent. Usually, this talent develops early, is nurtured with education, and has an associated profession. The typical professional in both fields enjoys his or her work but labors in obscurity. The examples of E. L. James from fan fiction and Linus Torvalds from open source software both feed the myth that a leisure activity will result in a life of fame and fortune. Such comparisons, however, quickly fall victim to economic disparities. While writing is big business, technology drives entire industries. For most people, writing software is a far more lucrative career than writing stories. While E. L. James is now a household name, like the female software engineer, our success is an exception rather than the norm. Without a revolution, we may be on a path to extinction.

Even if we do not account for the gender disparity, there is still a crisis in recruitment for the STEM field, especially in software development. Some Americans may perceive immigration as a threat to an American way of life by some, for computer jobs immigration is a savior. "Thankfully," the crisis is not so dire as to suggest hiring women instead even when this monoculture [read male-dominated] is bad for business. Diverse workplaces get better, more innovative results (Forbes, 2011), solve problems better (Hong & Page, 2004), and produce greater profits (Barta, Kleiner, & Neumann, 2012). Another key factor is a technical skill. Employers claim that only highest skilled people can do the work. Research shows that women are equal to, if not better than, men in technical ability. Women perceive themselves as less skilled, and men perceive themselves as more skilled than they really are (Kay, 2008). Popularly known as the

Dunning-Kruger effect (Kruger & Dunning, 1999), this trait is more pronounced in men than in women (Ehrlinger & Dunning, 2003). Thus, programming teams that do not have gender balance risk a below average level of programming skill. How can we prevent a world where a woman's only relationship to technology is to take nude selfies with her smartphone that male hackers can post online for their entertainment? That is a trick question. We cannot completely prevent that. But we can do something about it. Attempts to get girls interested in coding using games or other well-intentioned projects fail because their proponents do not recognize the most important part of this problem - that there is nothing wrong with women.

There is still the sign on the tree fort that reads, "No girls allowed!" Change will not come if the world embraces this broken model. While the software industry lobbies governments for imported workers, who fear deportation if they complain about working conditions or below-market wages. This industry also lays off tens of thousands of older workers doing the same jobs. Why would anyone want to work in this environment? While the lack of women in this endeavor may indeed be a sign of a broken system, we must not consider it as a sign that women are the ones who are broken and need to change. I argue that it is we, the women now working in the STEM-related fields, who must take the lead and fix the broken model. Transformation cannot occur without a revolution. To revolutionize the STEM-related fields, I propose a three-way strategy that starts with *iNfII7R@ti0n*, moves into *dI\$rUp7i0N*, and continues with *eNG@G3Ment*.

iNfII7R@ti0n, dI\$rUp7i0N, and eNG@G3Ment

We are at a decisive moment in history. Digital technologies are part of everyday life, and there are two full generations of women and minorities working in STEM-related fields. The prevalence of open source software and the image of the hacker is changing from the lone male coder to women wizards collaborating for change in Web 2.0. Our numbers may be in decline, but this is an opportunity for unprecedented growth. To revolutionize the STEM-related fields, I propose a three-way strategy that starts with *iNfII7R@ti0n*, moves into *dI\$rUp7i0N*, and continues with *eNG@G3Ment*. While these may appear to be sequential steps, they do not have to be. At any time in the process, all three may or may not be employed. All three represent the constant process of transformative relationships that are supported by a firm foundation (the standardized protocol or the gender expectations), adapts to a changing environment, and where changes occur at the

periphery.

Two concepts ground my idea of INFILTRATION – convergent feminisms (Lara, 1998) and Faulkner's (2005) "breaking the circuit." Lara's (1998) idea of convergence feminisms. Emerged from her analysis of the narratives in online social movements to understand how members create cohesiveness and solidarity, redefine the groups' collective understanding, and transform society or culture in some way to create new visions for the future (pp. 1-3). For her, the speaker (or performer) has explicit knowledge that mitigates the enactment that allows for fluid identity construction rather than static essentialism (p. 30). Because there is a danger in universalizing human rights and viewing them from within a Western cultural perspective, Lara called for a "convergence" of feminisms. This intersectionality allows multiple voices to be heard and valued and activists "converge" feminist ideals. Similarly, Falkner (2005) examined the two processes that must converge for women to thrive in the engineering culture. These are becoming an engineer and belonging as an engineer. To become an engineer is just the first step. To belong takes more than education and skill. To really belong both women and men must realize they are getting it right. It is all about visibility. Why do we accept the idea that we must be women first and experts second? This gendered invisibility diminishes the valuable contributions of diverse groups, and it is a layer that women face that men do not. We must infiltrate informal social cultures embedded in professional circuits. To do this, we must "break the circuit" (pp. 23-25). We must belong and lead.

I understand and acknowledge the power dynamics involved, but I also know there are ways to subvert them. I believe we are at a critical point in time when women are poised to infiltrate the male-dominated STEM cultures. Inclusion is good, but it is not enough. Inclusion means to be part of a whole. (For example, a good software app includes well-written code and clear documentation). In math, to be included is to be a subordinate element. I do not want to be a subordinate element, do you? INFILTRATION is necessary to transform the system. Women have closed the gap in access, and there are women in the hacker culture and open source movement who are motivated by their personal desire to open the doors to other women. According to Merriam-Webster's Online Dictionary to "infiltrate" is to gain access to enemy held territory, or to gain access gradually or surreptitiously. I define INFILTRATION as a way to motivate the process of change by passing through the cultural barriers to access and thrive in previously unlivable spaces. Unlike inclusion, which has historically relied on education and private initiatives to get

girls "into the pipeline," INFILTRATION is a purposeful proactive method for professional women to DISRUPT (disrupt) the symbolic connection of technology and masculinity. Hackers and open source coders are already doing this. Hacking culture is grounded in the ethos of sharing and collaboration. It is also where anyone with the love for envisioning new options thrives. Using our invisibility as a strategy, we can move into places without notice. For example, we can submit papers and panels to male-dominated conferences under pseudonyms and initials (i.e. George Elliot and J. K. Rowlings). We must work together as collaborating conspirators. One person creates a buzz, but a group creates a commotion. A group of groups creates an explosion that is hard to ignore. As infiltrators, women and minorities must become more than warm experts (Bakardjieva, 2005) Warm experts act on the system to bridge interests, share knowledge and improve cultural diversity. "The warm expert mediates between the technological universal and the concrete situation, needs and background of the novice user with whom s/he is in a close personal relationship" (p. 98). But I believe we need to be red hot experts who conspire to boost both the novice's and the expert's confidence that prepares them for the next phase of the revolution, DISRUPTION.

DISRUPTION in hacking terms is the dissing of protocol or performing interactions that may follow a defined procedure but do so by breaking the protocol's rules. This rupture can be done face-to-face (F2F), through formal and informal writing, or peer-to-peer (P2P). In F2F interactions, DISRUPTION should be an extension of the conference infiltration. For example, once at the conference, we preempt scheduled panels and replace them with rogue presentations conducted in the hallways or lunch areas of the conference venues and by spreading the word about these sessions using disruptive technology. In doing this, we operationalize Braidotti's (1994) argument of dismantling the rules that govern "normal" gender construction, and examine our own language use when doing so. We must stop using metaphors that reinforce the power-down position such as barrier/obstacles, and inclusion/exclusion and replace them with power-up metaphors such as opening/clearance and acceptance/support. We must resurrect Mary Daly's (1990) ideas that re/construct masculinized language to create something new. Two places for P2P DISRUPTION link to F2F and writing. Written disruptions in P2P venues could/should include the liberation of geek websites like GitHub or StackExchange or hacking conventional digital tools (like smartphones and tablets) to supersede the technology's original intent. Doing so makes them accessible to everyone--even if there is no reliable internet connection. An example of this is Freitas' (2015)

concept of "the Wind" an Internet-free P2P communication system. Freitas wrote. "Wind is a new metaphor, backed by a collection of standardized behaviors, to promote the development and adoption of direct nearby-capable application, services, and features, for smart devices. It builds upon the widespread availability through low-cost smartphones of multiple local area radio communications technologies, such as WifiDirect, Bluetooth (Classic and LE) and NFC/RFID" (WindfarmGitHub, Para 2). Wind is mobile, nimble, and dynamic. This di\$rup7i0N creates communication opportunities that not constricted by government sanctions or the lack of adequate bandwidth cannot stop. We already know how to do this. Revolutionaries in Costa Rica as the Feminist International Radio Endeavour (FIRE) disrupted the standard protocol of radio broadcasts to make global connections using the internet. di\$rup7i0N, we rupture the control mechanisms of the central authorities and transform them into trusted peripheral connections. A single rupture may not enough for a revolution. But, with each rupture, territory expands and, at each connection, we cr/hack the (gendered) system even more. Once in\$fil7R@ti0n and di\$rup7i0N are in place, we complete the revolutionary process with eNG@G3Ment.

eNG@G3Ment activates historically passive initiatives of traditional education and pipeline initiatives by increasing political advocacy and a producing a consistent stream of media events. I do not advocate for abandoning the passive strategies. There are many successes to praise. One of note is the Women's Society of Cyberjutsu (WSC) a non-profit organization led by women in the security industry. Their mission "is to advance women in cybersecurity by providing programs and partnerships that promote networking, education, mentoring, resource-sharing, and opportunities" (n.p. 2015). Not only do they connect like-minded women and girls, but they also teach cr/hacking, have workshops on public speaking, and produce TeqTalks. But WSC and similar initiatives are not enough to move to breaking the circuit of sexism. Wacjman's (1991, 2010) technofeminism approach informs my idea of eNG@G3Ment. She argued that technoscience and institutions "can be reshaped to accommodate women" (2010, p. 145). But for me, this is still a weak argument. We cannot accept "just" accommodation. We must achieve a thriving transformative society. eNG@G3Ment is more than education and collaboration. It is more than a pledge or promise for reform. It is more than winning over the audience to attract more support. eNG@G3Ment adds an element of risk but is also where we are proactive and obligated to participate in all the cultural perks to which we are entitled. It is about subversive, proactive and progressive events designed to bring public attention to the issues. Not one shot "mind bombs"

such as EarthFirst!'s stunt where they unfurled a banner over the Glen Canyon Dam that simulated a crack. But a series of related events that keeps our issues and objectives in the media for an extended period. We must eNG@G in a plurilogue with the goals of re/weaving the idea of community, connecting feminist thought, and transforming the essence of life, work, and leisure in a digital world. Bakhtin's dissonant polyphony informs my conceptualization of plurilogue. Plurilogue creates something new — a radical restructuring of the old world aesthetics around dialogue and debate (1984, 34-35). Shohot's (2002) idea also influences this idea that "links different yet co-implicated constituencies and areas of struggle" (p. 2).

The Revolution Is Here

Yes, there are powerful institutions that both limit and abuse the rights of contemporary women, and women have struggled to address these issues. But we cannot forget that we are also a powerful institution ourselves. All feminists are committed to social change, but those of us in the cr/hacking and STEM fields have a unique perspective on the problems faced by all women and diverse groups in (white) male-dominated careers. But it takes a revolution, and that is what has been missing in our forty year fight. If we still watch television that relies on stereotypes, share sexist links in social media such as "Female hackers that will make you feel uncomfortable" or buy toys for our children like Barbie the software engineer, who calls Ken to fix her computer, or accept Apple's advertising for Swift™ their programming language that is "so easy a girl can do it," we are still making the women excuse. But what is the point in solving gender disparity just at the time when the software engineering industry has been outsourced, offshored, commoditized, and finally turned into a purely leisure activity for the benefit of major international corporations? The answer is that this is a turning point that we, as programmers, designers, academics, hackers, and engineers in the STEM-related fields must use to our advantage to take our rightful places as valued colleagues and leaders. We need to cr/hack the system using iNfIl7R@ti0n (infiltration), dI\$rUp7i0N (disruption), and eNG@G3Ment (engagement). Let us go public and take a risk. Let us force the doors wide open and brazenly challenge the status quo using feminist activism. Let us start the revolution! It is not too late. I am ready, are you?

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