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Beyond the Blackbox: Repurposing ROM Hacking for Feminist Hacking/Making Practices

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While much interest in feminist technology looks to future inventions, dead or obsolete communication media, such as older smartphones, offers spaces in which to hack into effaced gendered narratives, specifically through physical processes of deconstruction and circuit bending. Thus, this practice brings attention to the tasks and narratives of circuit inspection and soldering of female workers, such as dagongmei, i.e. Chinese female migrant workers. Through resoldering and reassembling a ROM chip in older telecommunication media, exposed is the ways in which women's work in technology is blackboxed. Hacking the device in ways that make visible the work of women reconfigures this media as feminist technology. This hack draws from initiatives by scholars such as Lisa Parks and Lisa Nakamura, as well as DIY culture to trace, recover and discuss forms of female labor, inviting feminist technology to include affective, minority and domestic labor as critical production processes.

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Introduction

Many Nintendo Entertainment System (NES) video games were based on cartoon and toy franchises that embodied hegemonic masculinity, such as G.I. Joe, Beavis and Butthead, Darkwing Duck, Popeye, Transformers, and Toxic Invaders. These games not only reinforced views that males are/were the primary video game consumers, but that male power is reflected through the video games' hypermasculine traits. Several gender swapping hacks or mods have responded to this claim: for example, in 2012, Mike Mika created a *Donkey Kong* NES hack that places Pauline in the protagonist role that is usually occupied by Mario. While the ROM (read-only memory) hack was created for Mika's daughter, it garnered the attention of national news outlets, such as NPR, ABC News, and the Huffington Post, and it was shared thousands of times on social media. The emphasis on the man's actions and classification in the Donkey Kong hack news reports is representative of larger video game communities where there often is 'a lack of interest or even outright derision regarding games about domesticity and girlhood' (Alexander 2014). This has contributed to the popularization of narratives that concentrate on 'men's role in reshaping hegemonic video-game culture' and reinforces cultural assumptions of the default gender of video games (Weil 2013). Consequently, feminine/girly games as well as the women players, creators, and production laborers have been erased, excluded, and marginalized from larger historical narratives and certain video game communities.

To address the dominance of hegemonic masculinity in video game culture and the problems with supporting male-based intervention into this culture, such as the *Donkey Kong* hack, we must first consider what conditions predicated the need for such interventions. From the forgotten labor of the migrant women workers in Chinese electronics factories to the lack of attention paid to feminist artists and game developers creating deep hacks of classic games, women have been excluded from the mainstream conceptualization of the video game industry and larger tech culture. Correspondingly, this article poses the following questions: in what ways are women already contributing to this culture and why are they ignored/erased from the mainstream narrative? How can we imagine and/or produce feminist interventions or hacks into the hegemonic video game culture through ROM hacking?

In this article, I interrogate the inequalities and erasures developed throughout the design, production and consumption process of Nintendo video games by utilizing reverse-engineering methods, such as ROM hacking. ROM hacking is an 'umbrella term' referring 'to the direct manipulation of commercially released video-game program data to alter the original gameplay, graphics and sound or level designs,' and involves

deconstructing the physical game cartridge and circuit board as well as altering the ROM itself (Newman 2016, 4). ROM hacks have produced 'game modifications ranging from simple cosmetic hacks to full-fledged projects featuring new graphic art, music, game mechanics and level designs' and therefore enable infinite possibilities for hackers/users (Jordan 2007, 712). Many popular ROM hacks have focused on translation, level creation or general changes game play, however, artist Rachel Simone Weil intervenes at multiple levels, from visual aesthetics to character mods. Pink and pastel hues, flowers, hearts and lace adorn the landscape of artist Rachel Simone Weil's ROM (read-only memory) hack of the popular Nintendo Entertainment System game *Super Mario Bros.* The femme aesthetic of Weil's hack contrasts the stereotypical primary colors of the original game; it further challenges the game's gendered design by replacing Mario with the ultrafemme cartoon character Hello Kitty. In another example, drawing from the feminine aesthetic of the 1980s My Little Pony cartoon and toy line, Rachel Simone Weil's hack, *Faxie's Unicorn Blast*, 'reimagines the side-scrolling space shooter by replacing the typical warship with a cute toy unicorn' (Weil 2016a). This hack addresses both the gendered design of video games as well as the hegemonic masculinity of commodification in video game culture. Weil's hacks provide 'examinations of what does and does not have value – both monetary and cultural – in game history and collection' (Alexander 2014). Therefore, I use the feminized ROM hacks of artist Rachel Simone Weil as directed case studies to produce a discussion on both the negotiation and reimagination of femininity in video games and practices of feminist hacking/making. The structure of my argument is inspired the practice or steps of ROM hacking itself: beginning with an examination of the external console and cartridge, through the disassembly of the cartridge case and circuit board, continuing through the game modding and concluding with the reassembly of the physical game.

Configurations: Hacking, Making and Feminism

Hacking is often thought of as disruptive or deviant programming and in many popular movies and films hacking is depicted as a male-dominated activity that consists of (re)writing computer code. However, this representation of hacking is only one interpretation and hacking includes numerous device modifying actions such as 'soldering hardware, writing computer code, or building software applications' (SSL Nagbot 2016). Due to this variability of hacking practices, players that ROM hack video games disrupt a determined algorithm through code and more importantly transform it in distinct and unexpected ways (Jordan 2007, 708). Within hacking communities this transformative potential applies to not only the technical change but also social change

(SSL Nagbot 2016). As such, the hacker ethos embodies values of openness, accessibility, and decentralization; yet these values are based on empiricist and rationalist views of science that are historically associated with the masculine (SSL Nagbot 2016). The gendered associations are based on dichotomies – culture and nature, reason and emotion, objectivity and subjectivity – in each of which 'the former must dominate the latter and the latter… seems to be systematically associated with the feminine' (Wajcman 1991, 5). The embodiment of patriarchal values by Western technology is articulates the 'masculine culture of technology' that is intrinsic in the reproduction of the gender division of labour (21). It is this reproduction of gendered labor that often leads to the erasure or omission of women within hegemonic narratives of technology itself.

Complicit in the process of erasure is the practice of exclusion and many women are precluded or assumed to be precluded from the design and coding process (SSL Nagbot 2016; Weil 2013). This assumption is problematic as it reinforces inequalities in education and technical literacy systems that produce the very workers needed for the game console design and production. Even with the coding and technical skills required for work in video game industries or hacking communities, it is difficult for women to succeed in this industry because 'these skills are embedded in a culture of masculinity that is largely coterminous with the culture of technology' (Wajcman 1991, 19). Therefore, within their discussion of contemporary feminist hacking developments, the collective SSL Nagbot (2016) looks to the practice of making 'that draws from distinctly feminine configurations of invisible labor'. Making utilizes several of the socio-technical practices from hacking but through a DIY philosophy that 'assumes as a point of departure the materiality of technologies and locates inquiry and intervention at the processes of design, engineering, and artistic production' (SSL Nagbot 2016). Therefore, throughout this essay I use the term feminist hacking/making as it involves confronting the systemic problems of patriarchal social inequalities that are integrated and effecting at all levels of media technologies.

In micha cárdenas's (2012) work on pop stars such as Ke$ha and Lady Gaga, she articles the concept of femme disturbance that articulates the ways in which capitalist ethics and rationality is disturbed via queer femme affect, specifically as 'a combination of femme science and electronic disturbance' (178). Femme disturbance consists of acts that not only resist norms, but also in numerous ways inhabit norms, both of which contribute to the subject's agentival capacity (179). It is this dual role of embodiment as well as resistance that I see as useful in adapting ROM hacking to feminist

hacking/making. This is particularly visible in the Weil's ROM hacks that use femme aesthetics to construct new norms as well as comment and resist previous norms of feminine exclusion. While traditionally used to describe feminine lesbians, the term femme also describes the performance of femme identity through feminine-associated behaviors, aesthetics, speech patterns and other aspects of identity formulation, regardless of an individual's sexual or gender orientation (Eves 2004). It is in this context in which I use the term femme disturbance as feminist hacking/making practices should not and cannot be restrictive to any one community.

Dissection: Breaking the Black Box

Most users rarely think about the material inside their computers, beyond their screens or contained within the cartridge box. While this ignorance may seem natural, it is engineered and embedded within the hardware's design itself. Most 'technological objects are designed as a 'black box'—not engineered to be fixable and with no user-serviceable parts inside' and purposely unintelligible to users (Hertz and Parikka 2012, 426; Jordan 2007, 710). During the design of video game cartridge, this ignorance about digital materiality was a primary design factor as the original cartridge designers faced the problem of technically illiterate consumers interacting with extremely fragile hardware (Edwards 2015). Designers drew inspiration from the enclosure of magnetic tape in 8-track tape cartridges, as it similarity prevented technical illiterate from accessing the important hardware (Edwards 2015). The plastic game cartridge then acts as both a metaphorical and literal black box and resulting in further user technical illiteracy, obfuscation of game construction and forced acceptance of the game system rules.

To open the video game cartridge or break the black box, hackers/users must have the proper tools and knowledge of these tools. The first step of ROM hacking is to detach the screws located on the back of the game cartridge. These screws vary in number, size and shape and therefore the hacker must know type of screwdriver needed for each cartridge type.[1] The tools and the knowledge about their use is deeply tied to problematic assumptions and practices of the gendered division of labor. Traditionally, women were thought to be responsible for household chores, childrearing and other 'care' based tasks, while men's primary household responsibilities including repairing broken things, taking care of utilities, and overseeing any construction. As such tools used for repair and construction, such as screwdrivers and power tools, have become a 'symbol of masculinity' that helps cultivate ''masculine legitimacy of skilled labor' in the homes and for men to retain 'the aura of pre-industrial vocational masculinity''

(Bardzell et al. 2011, 373). The man's role as domestic handyman is reinforced by the screwdriver design itself, as many drilling tools are too heavy or too large for women to use (375). These assumptive design practices demonstrate a reoccurring theme throughout hardware examination: that the tools required for ROM hacking are almost always designed by men for men. Along with the ROM hacking methodology, I propose the use of alternative tools to help preclude the gendering of handyman labor. For example, researchers have developed a screwdriver that considered the different needs of male and female users in terms of form, function, awareness, anticipation of use, and context of use (Bardzell et al. 2011). The resulting tool, the Significant Screwdriver, was a well-received prototype that made explicit expressions of care and love (374). Thus, the tools as well as the hardware requires consistent interventions that consider those excluded, whether through technical know-how or physical strength.

Bringing attention to the tools and processes of production is a key element for the effective application of ROM hacking for feminist hacking/making. In her hacked game, *Track + Feel II*, Rachel Simone Weil offers an example of hacking/making that combines the development of alternative tools and exposure of production process. *Track + Feel II* is 'a cooperative, interactive, glitch-art and music creation tool for the NES,' that produces real-time glitched animations and melodies controlled by players dancing on a connected NES power pad mat (Weil 2016b). In this example, the tools and their functionality are made tangible through the visual glitches and user-produced melodies. *Track + Feel II* also creates an alternative tool as users write program changes within the actual game through game play. This type of hacked game, which allows users to become the designers, shifts labor performed and over time increases technical competence, which is often cited as incompatible with femininity (Wajcman 1991, 38). *Track + Feel II* 'makes use of the NES' unique graphical tile arrangement system to in order to create graphical glitches using the console's unique hardware configurations' and offers an intervention in the masculinity inscribed in technical know-how and platform design (Deeming 2012). This hack demands a high level of skill and a 'deep understanding' of the platform design and thus through exhibiting a high level of technical skill, Weil is disproving the masculinity legitimacy of skilled labor. Weil further critiques the production of masculine legitimacy by making gendering practices visible through an emphasis on feminine aesthetics in her hacks. As such, Weil's aesthetically feminine hacks 'enable the post-consumer player (artist) to contribute to the redefinition of the platform and how it is situated in our culture' (Deeming 2012). By combining highly technical work with 'feminine game design tropes like pastel roses and baby-pink bows,' Weil's work not only contributes to redefinitions of platforms but

also challenges our practices of gendering technical know-how and technological tools (Williams 2013).

An important part of technical knowledge is the categorization and terminology of cartridge parts and tools. While video game cartridge circuit board design changes between games, manufacturers and decades, there are several main components in most mainstream games manufactured between 1980-1996: the program code memory (PRG), the character graphics memory (CHR), and the male connector pins. The program code memory ROM chip's metal pins form the 'male' connector prongs, which are inserted into a mirror configuration of 'female' pin receptors on the console device. When the male and female connectors touch, electricity flows, and the console 'reads' the program on the circuit board. The use of gender in describing contact points extends past the invention of circuit boards, to early electrical outlets and plugs. These terms are based directly on sex organs, and consequently gender becomes representative of the basic idea of difference. This concept is deeply embedded in electronics, and in contemporary culture, the terms male/female are used in contact couplings from HDMI cables to plumbing fittings. Noting the ubiquitous integration of gender as essential difference highlights the ways in which gendered discourse applies and circulates, even when unintended or unconscious. Furthermore, it demonstrates the alignment or connection between gendered discourse and technocracy as argued by Judy Wajcman and many other important feminist STS scholars.

Technical know-how is applicable at both the intangible and physical level as after the screws have been removed, ROM hackers must 'pop' open the video game cartridge. Occasionally the two plastic sides have been glued together and this may require force. The circuit board inside may or may not be directly attached with screws to the plastic outer cartridge. Again, (male dominated) technical literacy, knowledge of tools, and general electronics experience are helpful when extracting the circuit board from the cartridge. Once freed from the cartridge, a closer examination of the circuit board hardware is needed to reveal the invisible labor of technical production from the women assembly workers to the hardware architects.

Contours: Crafts, Chips and Circuit Boards

The black box of video game cartridges not only hides the internal hardware but also the invisible labor of technological production. It is precisely this invisible work which making/hacking, specifically ROM hacking, attempts to expose through encouraging users to open the black box. In this stage, the ROM chip and the circuit board are

disconnected and thus in this section, I take both the ROM chip and the circuit board as objects of analysis. To develop ROM hacking within the context of feminist hacking/making, I believe that the use of media history provides important cultural forces that influenced and are influenced by the development of electronic technology. Therefore, I conduct concurrent investigations into materiality of the circuit board and the processes of technological production, i.e., circuit board and ROM chip assembly. Connections between the assembly women's labor and the feminized labor of crafting and weaving provides context for the role of feminist making/hacking through ROM hacking within larger socio-political movements.

The process of decoupling the ROM chip from the circuit board involves severing the connection between each male pin on the ROM chip and its female counterpart on the circuit board. Therefore, before physical manipulation, the points of contact must be identified by the hacker/user, which implies an understanding of circuit board architecture. Many comparisons have been made between the complex circuit board architecture and various weaving patterns. Weaving as well as other crafting practices of knitting and sewing are distinctly gendered because of socio-historical and productive forces (Minahan and Cox 2007, 13). During the Industrial Revolution, the main location of productive labor moved from the home to factories and workshops and thereby separated home and work into different spheres (Callen 1985, 1). This lead to the feminization of craft work as it could be conducted within the domestic space and due to its low wages did not undermine the male-orientation of the major family income provider. Projects such as the Langden Linen Industry were intended to 'occupy "idle" female hands within the home … stem rural depopulation, stave off increasing urban squalor and unrest, and maintain the traditional status quo in the countryside' (2). Concurrently, domestic activity, such as childrearing and cooking, was not conceptualized as *real* work and reinforced these divisions between genders within separate spheres (1). The material, productive forces, i.e. the women's labor and craft goods, contributed to the increasing polarization of social relations along gendered lines and thus contributed to the contemporary associations of crafting and femininity. Therefore, gaining the knowledge required to identify the contacts that need to be desoldered can be a means of reclaiming the technology as feminine.

Using a hyper-feminine or femme approach that celebrates and performs the feminization of weaving and crafting through circuit board design begins to undermine the ambivalence of the male-designed-but-female-built technology. Although Weil does not make a direct connection to weaving, she cites her interest in crafting and the early

2000s 'popular feminist reclamation of crafts such as knitting and cross-stitch' as inspiration for her feminist-driven ROM hacks. These hacks employ a strategy of overt feminization by altering the games visuals to include '8-bit flowers, lace, and candy hearts' (Weil 2016a). In the famous *Hello Kitty Land* hack, the application of the feminine aesthetic defamiliarizes the typical NES user. It draws attention to the encoded gender elements of the game such as the color scheme and the industrial, mechanical obstacles, i.e., the pipe system. *Hello Kitty Land* forces the player to 'reinterpret 8-bit visual language from an era in which gaming was primarily conceived of as a boys' pastime' (Weil 2016a). As such, emphasizing the feminine through visual aesthetics that draw from feminist craft movements reclaims this important part of women's history and reconfigures it as a tool for critical reflection. cárdenas (2012) argues that although the artist Ke$ha can be seen as reproducing the 'structure of racialized, gendered power that increasingly sexualizes younger women through commodities,' she also defines her own norm of 'excessively glittered femme expression' (183). *Hello Kitty Land* functions similarly: it reproduces gendered structures through utilizing gendered commodities, but enacts its own norm through association of hyper femme aesthetics and disturbance of the masculinity in 8-bit language. In doing so, *Hello Kitty Land* delineates femme disturbance is an important theoretical frame that argues femme affect destabilizes the capitalist ethics of competition, individualism, and hierarchy; 'all of which are ethics that provide the logic for structural violences of social exclusion, such as patriarchy, white supremacy, ableism, and US/Euro centrism' (178).

The process of decoupling the ROM chip from the circuit board involves desoldering, which severs the connection between each male pin on the ROM chip and its female counterpart on the circuit board. Soldering is a 'technique for creating permanent electrical and mechanical connections between metals' through applying heat to two points (Biomedical Mechanical and Electronic Workshop, n.d., 1). This causes a chemical reaction between materials that results in the creation of an alloy which acts as a bridge for electricity between the two points (1). Desoldering is the breaking of this connection and includes a chemical reaction. The decoupling of the circuit board and ROM chip, as well as altering the actual metallic composition of the parts, is a performative act, which undoes the previous work of the assembly laborer. Thus, while this stage of ROM hacking makes the labor associated with electronic assembly visible, it simultaneously erases it. The problems that arise from desoldering the ROM are important as gendered labor constitutes a major portion of electronics assembly and manufacturing work.

The feminization of crafts is important as it has been used to justify the erasure of women's work in computing, particularly those in the assembly and manufacturing of circuit boards. In Lisa Nakamura's seminal work 'Indigenous Circuits: Navajo Women and the Racialization of Early Electronic Manufacture,' she uncovers the history of Navajo women workers at the Fairchild Semiconductor plant in early technology manufacturing (Edwards 2015). This is conducted through interrogating the various materials, such as company's brochures, internal articles, and press releases, which claim the 'inherent flexibility and dexterity of the Indians' as justification for the exploitation of Navajo women (Nakamura 2014, 926). The gendered and affective nature of Navajo women's work is likened to weaving by Fairchild and is misrepresented as unimportant and distinctive from material production in the accepted narratives of electronics history (921). Perhaps most telling is that Fairchild's practices have received little attention in the history of computing; this exclusion or erasure gestures toward the larger trend of obfuscation of women's work in the video game industry and hacking culture.

Similar projections of women's work, crafting, and exploitation occur in the construction of circuit boards and contemporary semiconductor materials, both of which are present in the video game cartridge circuit board and ROM chip. The circuit board is an arena in which complex interactions occur between: the abstraction of human labor through the employment of manufacturing factory workers and engineers; the organization of labor based on exchange value; and the expansion of the labor market. In many Asian electronic and electrical industry markets, the majority of the workforce are women: in Thailand half of all E&E employees are women and women occupy seventy-six percent of the E&E 'elementary occupations' (Errighi and Bodwell 2017, 21). In Malaysia, 20-60 percent of the electronics industry are migrants and 70-80 percent of these migrant workers are women (7). This problem is even more pronounced in China where young women constitute over seventy percent of the workforce in electronics, garment, and toy industries (Ngai 2007, 240). While other countries like Indonesia have seen changes to gender distribution in the manufacturing sector, China has consistently seen massive division between laborers based on gender (Caraway 2007, 26). This is pronounced in the largest Chinese electronics company, Foxconn, which accounts for over half of the world's electronics manufacturing and service market (Ngai and Chan 2012, 387). Eighty-five percent of Foxconn's workers are migrant young workers with no permanent residence and almost always of the female gender (Pun and Chan 2013, 385). These female workers are usually from poor rural families, have had little education and must live in overcrowded and often insanitary

company-provided dorms (Ngai 2007, 242). Called the dagongmei, they represent 'a new gendered labor identity produced during the emergence of private and transnational capital in post-socialist China' (242).

Just as the dexterity of Navajo women was used by Fairchild to justify employment of women to lower skilled labor positions, Asian electronics assembly companies have argued that the 'nimble fingers, small hands, [and] proclivity for working on the small scale' to rationalize the majority of female assembly workers (Vágnerová 2017, 251). Studies of gendered discourses of work 'vacillate between treating gendered discourses of work as managerial subterfuge or as traits that women actually possess,' such as the nimbleness and ability of women to work with small, complex electronic parts (Caraway 2007, 29). However, whether these traits are produced by discourses or are inherently natural is unimportant; what matters is that employers believe women possess these traits (30). Furthermore, other traits such as 'tolerance for tedium, obedience, docility, innate respect for male authority, patience,' and inability organize are attributed to these women and stem from the naturalization of submission and emotion/care as distinctly feminine. Based on these naturalized assumptions, the processes of production result in a bodily discipline as the assembly women must sit for hours with heads and necks bent forward at a station where they repeat the same movements thousands of times a day. This work often results in 'musculoskeletal disorders in the neck and back' and the literal wearing away at 'the instruments of production – for instance, eyes fitted to microscopes, fingers eaten away by chemicals' and increases in miscarriage rates (Aghilinejad et al. 2016, 446; Vágnerová 2017, 254). However, these physical and culturally constructed abilities are not conceptualized as skills and thus 'the discursive construction of skill is a key pivot point: the assumption of women's essential proclivity for delicate busywork leads to naming their labour unskilled' (Vágnerová 2017, 254). As employers designate the relationships between categories of labor and gender, the dagongmei as well as the Navajo women, who are estranged from themselves, adopt these identities, and thus influence the process of media technology manufacturing and assembly. There are real consequences, seen in the depth of gender inequalities in these factories: 'the gender hierarchy almost completely overlaps with the supervisory labor-production worker hierarchy, with 80 percent of the production workers being women, and factory directors, managers, and most of the foremen being males' (Ngai 2007, 247)

The feminist hacking/making method I propose applies to the material as well as the material history, and it needs to emphasize the origins of the material through the

contributions of gendered labor, as they are included in the objectification process. The exploitative labor processes also transform 'their bodies into objects for consumption' while they are 'forced to confront themselves as something hostile and alien' (Cross 2012, 7). Thus, alienation is not only the estrangement of labor and products but of the dagongmei's own identities and the identities of feminist hackers/makers. While this estrangement may seem to strip all workers' agency, intersectional labor scholars have observed recent organizational movements in the Global South within informal or non-traditional labor communities. These informal and precarious workers 'tend to adopt an intersectional approach to class politics, emphasizing that the roots of economic subordination are as much about class inequality as they are about social discrimination along lines of gender, ethnicity, family and migration status' (Chun and Agarwala 2016, 636). This approach includes an emphasis on education, wages, childcare, working conditions and housing, many of which are important issues for the dagongmei and other female assembly workers as well as the feminist hackers and makers (636). Reconceptualizing labor communities to include informal and non-traditional labor reveals the agency that these marginalized workers do possess and demonstrates the ideological shift that needs to be assimilated into the feminist ROM hacking ethos. Incorporating the aspects of love and care as well as social discrimination of gender, race and migration status from the labor of weaving and other femme crafting practices into the ROM hack mirrors this intersectional effort and speaks to the power of collective solidarity.

An intersectional approach 'also reveals the interlocking nature of oppressions that shape workers' job contexts and everyday lives,' which is particularly relevant for the dagongmei who must live in unsafe and overcrowded dormitories (Chun and Agarwala 2016, 641). Not only is the dagongmei's work precarious, so too are their homes. In China, the hukou system determines the residency status of individuals based on the classification of an individual's birthplace as either rural or urban (Sheehan 2017). The dagongmei as rural residents are not entitled to public services within urban environments and cannot obtain home loans; as such, the dagongmei must depend on the company for lodging (Sheehan 2017). This has recently emerged in international news through public suicides by the dagongmei and other factory workers in China. While highly tragic and extreme, there has been a visceral moral response to these deaths that has seen allies and those in positions of privilege advocate for better wages, improved working conditions, and the worker's right to freedom of association (Chun and Agarwala 2016, 642). As a result, the Chinese 'precarious workers have developed new labour NGOs that offer workers legal and social services while also helping foster

some forms of mobilization' (642). The reconfiguration of labor also connects to the plurality or mulitiple modes of inhabiting that femme disturbance claims. Rather than inhabiting a binary of resistance and habitation, these workers are 'both inhabiting and creating norms, as nodes in networks, which use lines of communication to form new assemblages' (cárdenas 2012, 180).

Encoding: Hex Editing and Assembly Language

After detaching the ROM from the circuit board, hackers/users then alter the game itself. On a separate computer a copy of the game is obtained either through the extraction of videogame software from the ROM chip or (usually illegal) downloaded software. It is this downloaded or extracted version that the hacker manipulates often through a process called hex editing. This is done through a hex editor program which displays the software code or data in hexadecimal notion that can then be directly manipulated by the hacker/user. The hex editor like many of the other hacking tools requires specific knowledge of hex notation, code location, and game architecture. Through the hex editor ROM hackers can change the music, the game play speed, and most other major components of the game. Other methods of game manipulation include writing scripts in 6502 Assembly language, which requires fluency in the programming language as well as knowledge in specific hardware applications of the language – most of which is undocumented due to the language being used primarily in the 1970s and 1980s. Due to the level of technical literacy required and the connection between coding skills and gender, many in the ROM hacking community assume the gender of the hacker is male. In an article on ROM hacking, one author states that 'a romhacker can't do a thing (well, kind of) if *he* does not have a translator and someone good at graphics (except if *HE* can translate as well and / or edit graphics)' (Dragon 2005 [emphasis mine]). The default gender of the hacker is almost always assumed to be male and points to the tendency to exclude or perceive the exclusion of women from the ROM hacking scene.

On Romhacking.net, a site which consists of the largest ROM hacking community, a heated debate about the exclusion of women reveals the ways in which the underlying structures of gendered relations shape the technology produced. In this well-known exchange, the infamous hacker Dr. Floppy argued that five key 'factors' were responsible for the dearth of women in ROM hacking communities: (1) there are less female video game users due to the inherent competitive/aggressive nature of men and passive nature of women; (2) because men are more analytical they are more successful at analytical hobbies like ROM hacking; (3) differences in how genders react to

adversity – men analyze and strategize whereas women run 'off to the nearest authority figure;' (4) men react better to failure; (5) difference in dispersion of intellect – 'the bell curve for males is shorter and wider… there are more male geniuses' (Popehentai 2016a). Many of these factors have been scientifically disproven and/or widely disputed by social and gender theories; however, this post provides insight into how gender is constructed in ROM hacking communities. For many of the male ROM hackers, women may possess knowledge about ROM functionality and hex editing, but the 'key to power is flexible, transferable skills and these are still the property of men' (Wajcman 1991, 39). As one respondent to Dr. Floppy points out, women have been a critical creative force in the ROM hacking scene, but they are often less visible due to the pervasive belief that 'femininity is incompatible with technological competence' (38). The skills and technical access required for hex editing and program burning is an important site of analysis and illustrates another level of gender bias within video games. Using ROM hacking in feminist hacking/meaning makes visible the historical impediments for women's advancement within technical professions as well as developing methodologies for demonstrating and counteracting these gendered barriers.

One way to confront this gendered bias is through hacks that draw attention to the technical and paratextual elements of video games. In Rachel Simone Weil's hack of *Mega Man II* (titled the Barbie Dreams Type Hack), the original typeface is replaced with the typeface from the *Barbie* NES game. While this hack only makes minor adjustments to the game, the hack 'asks the player to consider the importance of small visual cues and the social implications of game hacking' ("Mega Man II [Barbie Dreams Type Hack]" n.d.). It forces the user to ask whether femininity exists or can exist within a NES library and what impact does feminine hacks have on video game nostalgia. Altering the text is a surprisingly effective way to promote critical reflection on the hypermasculinity in video game design and to draw attention to those creating the hacks as well as the technology itself. Gender swap hacks, such as the Donkey Kong/Pauline hack do pose valid questions as to women's representations in video games, but hacks like the *Barbie/Mega Man II* hack reflect on femininity within video games, from design to user experience. Weil's *Hello Kitty Land* best exemplifies the critical engagement with femininity in video game design. In using a Tile Data Editor, 'which allows character and background graphics to be edited and redesigned,' as well as a hex editor and/or 6502 Assembly coding, everything from the sky's pastel hues to the replacement of coins with hearts interjects typical femme visuals (Newman 2016, 5). As such, both *Barbie/Mega Man II* and *Hello Kitty Land* involve 'not so much the

creation of norms out of nothing, but a selection of existing norms of femininity, musical styles, and sexualized embodied gestures, remixed or modulated' into a particular performance (cárdenas 2012, 184). These hacks not only change the representation of female characters but the representation of how we assign gender traits, how they impact our experiences, and ultimately how we gender technology in video game culture. By visualizing femininity within a paratextual element that is so familiar to the user, questions of femininity within video games become a prominent and unavoidable feature.

The naturalized connection between know-how and gender manifests in both ROM hacking communities and in the assembly process. In many of the E&E industry factories, women are lacking, or appear to be lacking, the skills or knowledge required for higher-paying positions like managers and engineers. This absence of credibility or value forces a greater division between skilled and unskilled labor and thus enables the devaluation of women's work which translates into lower wages and fewer opportunities for economic class change. The devaluation of women's work is also apparent in video game hacks that interact with concepts of gender, whether through femme visual aesthetics or reverse-gendering characters. When Weil introduced femme aesthetics into video games, 'audiences responded positively, but many would tell her they thought her aesthetic choices were 'funny' or 'ironic' (Alexander 2014). Even in hacks that only employ gender neutralization or character swaps, there has been little respect given in the ROM hacking community. In response to the release of several gender-neutral hacks, which changed only the pronouns and names of characters to be gender neutral, reviewers called these changes 'disgusting' and useless (Popehentai 2016b). One reviewer questioned the purpose of these hacks, asking 'why enforce this onto video games by making male RPG boys reduced their manhood to gender-neutral hermaphrodites' (Popehentai 2016b). In this instance, those lacking a penis (and more importantly Phallus) are figured less than the males who possess this physical organ (and privileged signifier). As the Phallus is a signifier of the lack of sexual difference, women along with gender-neutral individuals are cast as less than/lacking power. This depreciates the value of swapping character's genders, such as in the Donkey Kong/Pauline hack and casts such hacks as silly or frivolous.

Responding to criticisms about the value of feminized content, Weil employs a counterstrategy by emboldening those so-called silly or frivolous aspects. Weil contends that using the ultrafeminine aesthetic makes the old hardware feel 'at once sentimental, dissonant, strange, political, feminist' and thus simultaneously defamiliarizes and

reintroduces video games within the context of femininity (2016a). In *Hello Kitty Land* and other femme ROM hacks, game visuals are at once familiar through feminine tropes, but also disorienting as the hacks place feminine visuals in a primarily masculine platform and thereby poses the question of whether 'women feel nostalgic about games they were not permitted to play as children' (Weil 2016a). Using the aesthetically femme text from the *Barbie* game in *MegaMan II* not only makes femininity present but also speaks to the wider range of female experience. Current criticisms of video games often align with beliefs 'that princesses are sexist, that pink is just cynical pandering that reinforces gender roles, and that such a binary history embarrasses the medium' (Alexander 2014). Weil pushes against these with her use of ultrafemme aesthetics includes stereotypical girly identity, which has been performed by generations of women and projected onto these women. Weil argues that it is 'important not to erase girls' and women's experiences' because 'works by or for women are so often deemed marginal or embarrassing or inadequate or inappropriate, and therefore omitted from history' (Alexander 2014). This erasure of certain women's experiences leads to larger exclusions of women within technological and cultural history and thereby reinforces the dominant culture of hegemonic masculinity. Weil's work performs the crucial task of recovering and reintroducing women's experiences into these historical narratives and attempts to reconcile the devaluation and gendering processes with the production of feminine driven nostalgia, enacting a type of femme disturbance.

Reconciliation: Burning and Re-Assembly

After editing the game, the program is burned onto a new or repurposed ROM using an EPROM burner, resoldered onto the circuit board and the cartridge is reassembled. The skills, knowledge and access to EPROM burning technology once more illustrate the perpetuation of the masculinity inherent in cultural constructed technological practices. After burning the program, the new ROM is soldered back onto the circuit board, and the cartridge is reassembled. The performance or action of re-assembly engenders reflections on the physical labor in the task of ROM hacking, and recalls the labor of the dagongmei, as well as the Navajo women. This action is representative of how physical interaction and alteration of materials, also changes our understanding of media technologies. Through a focus on the materialities of ROM hacking, the social, cultural and political contexts of video game cartridges emerge and gesture toward further areas of inquiry, such as raw material processing, global labor chains, and representations of gender in video games.

Due to the complicated manufacturing history of each circuit board, ROM hacking is a reactionary performance beyond basic chemistry; it concurrently erases and recognizes the dagongmei's labor. Therefore, as an object, the circuit board and ROM chip are dismantled and reconstructed as objects and tools to develop conceptualizations of labor that extend beyond traditional formal employment and embody the multiplicity of femme disturbance. Future hacks that incorporate critical engagement with gendering discourses is suggested, through using character modding and circuit bending as other feminist hacking/making practices that inclusion the non-traditional and informal labor of the dagongmei, the women programmers, the feminist hackers and makers and even mother nature herself.

Developing methodologies of feminist hacking/making through ROM hacking practices is increasingly important as ROM hacking itself is becoming assimilated into mainstream culture. While ROM hacking is still practiced primarily in subcultures and online communities, it has inspired changes to official products, such as the new ability to design levels and characters in the game *Super Mario Maker*, for the Nintendo Wii (Newman 2016, 4). The ability to create levels and characters in-game claim to free users, but there are still programmed restrictions such as users can only make alterations within a set of limited options (4). Players can save their games, but SMM comes with legal and technical limitations encoded and invisible in the game design as opposed to the material and technical limits visible in Weil's *Track and Feel II.* The opacity of game design and its influence SMM player-generated 'hacks' only reproduces the dominance of masculine in the culture of technology as tools and skills to modify game design are still controlled by the usually male game designer. Therefore, the video game is still 'an instrument of domination' and the player's knowledge of game design is part of the commodity itself (Wajcman 1991, 59). As such, ROM hacking video games, along with critically analyzing the histories of the hacked media, which includes the process of media resurrection for 'new uses, contexts and adaptations,' outlines an approach that can effectively extend conceptions of feminist hacking/making (Hertz and Parikka 2012, 429).

As we develop the concept and practice of feminist hacking/making through a ROM hacking methodology, we need to advocate that the processes of creation are in constant dialogue with the objects, tools, and histories involved. Considering the non-neutrality of the tools and their histories informs the hacker and the material itself, and I believe the focus on material production in ROM hacking produces innovative engagement between video games and feminist hacking/making practices. Weil's hacks

offer a methodological starting point that involves a reconciliatory dialectic or femme disturbance between the problems of gendering practices and the reclamation of gendered labor. As ROM hacking becomes more popular and gaming seeks to become more comprehensive, Weil's work is an example of how it is 'possible to rewrite history so that underrepresented or undervalued fans may see themselves in it' (Alexander 2014). We can start to envision future feminist hacks of video games that address the gendered issues of exploitation and restriction from material analysis. In one ROM hack of *Super Mario Bros* recently undertaken, I visualize the assembly women's labor through the exploitation and otherness of Goombas and interrogate the gendered restrictions of Princess Peach's professional advancement through ultrafeminine movements and expressions. The exploitation of women in electronic component manufacturing industries, the dismissal of femininity and female hackers in video games, and the gendered barriers to access of technical skills and professions are exposed during the practices of critically-informed ROM hacking. The integration of feminist issues into the creative process of ROM hacking makes transparent underlying discourse that structures our understanding and employment of gender within video games. Confronting the ways in which technology is gendered and gendering produces a complex dialogue on the forces of production, cultural and media institutions, and the transformative potential of feminist hacking/making that looks beyond or rather within the black box of modern technology.

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1. NES cartridge type A (small flat head screwdriver), NES cartridge type B (3.8mm security bit screwdriver), N64 cartridge (3.8mm security bit screwdriver and small Phillips head), Gameboy Advance cartridge (tri-wing head screwdriver), Sega Genesis cartridge (4.5 mm security bit) ↵

BLACKBOX FEMALE LABOR FEMINIST HACKING/MAKING FEMME DISTURBANCE PEER REVIEWED ROM HACKING

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