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WEARABLE INTERFACES, NETWORKED BODIES, AND FEMINIST SLEEPER AGENTS

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Bodies have a history of troubled relation to machines. From metaphors of Cartesian dualism that align the body/mind split with machine/code (see Moravec 1988; Kurzweil 1991, 1999), to popular and scholarly rhetoric that celebrated the networked computer as a means of social interactions that transcend the body (see Stone 1991; Rheingold 1993; MCI 1997), to the project of recovering histories of the bodies who labored on early machines, such as the women who programmed early computers (see Stanley 1995; Abbate 2012), bodies have never been in a stable, locatable position in relation to machines.

Wearable technology does little to clarify this relationship. Steve Mann is often cited as the forefather of wearable computing and has earned a reputation as the world's first cyborg. Much of Mann's early work grows out of asymmetrical systems of surveillance (Mann 1998). His experiments in wearing recording or computing equipment in public spaces were in response to him frequently being subjected to surveillance without the option to look back. In the decades that Mann has been wearing his devices, he has been assaulted, had them forcibly removed, and reported experiences of extreme disorientation from wearing them (Buchanan 2013). Mann's evolving relationship to his equipment and the resulting anxieties and physical effects indicate that the relationship between bodies and machines remains in flux.

Oft-cited examples of earlier wearable technology derive from the worlds of computation and art: Edward Thorp and Claude Shannon's wearable counting device (developed for cheating at roulette) and Atsuko Tanaka's 1956 "Electric Dress." There are likely many examples that could be added to these two. One that I find particularly noteworthy is VALIE EXPORT's 1968 performance art, *Tapp und Tastkino* (*Tap and Touch Cinema*). In the performance, EXPORT wears a television-shaped shell over her upper torso. Viewers are invited to experience what EXPORT calls the "first immediate women's film" (Medien Kunst Netz n.d.). The viewer parts curtains, reminiscent of those that hide a stage or movie screen, and places their arms inside the box, which sits over EXPORT's breasts. This example is notable

for the prominence given to the body as mediated rather than as a carrier or platform for the technology.

Much current research is devoted to the development of wearable devices in engineering, computing, and medical fields. In the fields of fashion or design, wearable computing is largely treated as a means to achieve aesthetic ends, or as part of a wider context of technological developments in areas such as textile innovation. There is less research that addresses the cultural or ethical dimensions of wearable computing. In media studies or digital humanities, there is a fair amount on technologies that are sometimes worn on the body, such as portable cassette players, virtual reality hardware, MP3 players, and mobile computing. However, research on wearable computing proper—computing technologies designed primarily to be worn on the body as a garment or accessory—is still in the nascent stages. Pedersen's *Ready to Wear* (2013) addresses the rhetoric around wearable technology as augmented reality, and Rettberg's *Seeing Ourselves through Technology* (2014) addresses multiple modes of technological self-representation. One of these modes is the Quantified Self movement, a community that uses data tracking, often from fitness trackers, as a means to know the self. Ryan's *Garments of Paradise: Wearable Discourse in the Digital Age* (2014) is probably the most in-depth treatment to date of wearable technology from a humanist perspective. Ryan, an art historian, emphasizes the need to treat wearable technology through the lens of dress and takes the reader through a richly detailed history of wearable computing as evolving out of the "Borg Lab" group at MIT, with Steve Mann and Thad Starner among its notable alumni.

The interface is central to Ryan's reading of wearable technology. The interfaces of wearable tech are either invisible or, if visible, material and critical. Her emphasis on visibility of the interface seems to largely break down into applied research for commercial development, which strives for invisibility, and art, in which the technology is foregrounded either as an aesthetic strategy of dress (material) or for the purposes of social critique that she calls "dress acts" (critical). Dress acts are material analogues of "speech acts." They are performative in that clothing creates a text from which some meaning can be decoded, though this meaning is variable since it is embedded in historical and cultural signifying structures (Ryan 2014: 10).

Material, lived bodies are absent from Ryan's formulation of the "dress act." Her engagement with the body is most often as a generalized construction of embodiment (subjectivity as experienced through the culturally produced body and, in this particular case, its relation to technology), with an occasional focus on gendered systems of meaning. She acknowledges this oversight, writing, "I leave specific feminist theoretical analysis to future scholarship" (2014: 4). We share an interest in developing a critical framework for wearable computing and an interest in the role of the interface. Indeed, a feminist theoretical analysis of interfaces would re-introduce the materiality of the body, conceptualizing the interface as part of a dress-body-technology assemblage.

The body is never a neutral site of the interface. For instance, *Tap and Touch Cinema* explicitly refuses the ruse of neutrality, a refusal it shares with other feminist, touch-based performance art. Vasseleu writes, "Broadly speaking, feminist artists latched onto the fact that touching pertains to a bodily act and affect, not a bodiless presence devoid of social and historical context or cultural standing" (2015: 296). Touch has a bodily presence, even when it is not between two bodies, but instead the zone of contact in a dress-body-technology assemblage. Though the garment and/or device may remain materially stable, the ways they shape and are shaped are influenced by bodily presence. The body is framed by touching them as well.

In short, as an interface, the dress-body-technology assemblage is not a stable entity. It is a process. The importance of the interface as a process can be traced in multiple recent theories. For example, in *Window|Interface,* Eckmann and Koepnick theorize the interface not as a neutral window, but as always having been a zone of contact, which HCI allows us to understand with new awareness. Koepnick writes, "Instead, interfaces are sites of virtual transport and dislocation that have the power to carry us to other temporal and spatial orders while also inserting different orders into our own physical surroundings" (2007: 19). Much of Koepnick and Eckmann's theorizing is related to the increasing ubiquity of screen-based interfaces in the mid-2000s. As Eckmann notes, the window/screen as an interface not only has a material function, but also acts as a conceptual paradigm (2007: 61). Thus, even though the screen is absent in most wearable media, it still functions as a conceptual device that frames the processual operations of the dress-body-technology assemblage.

Galloway elaborates on the concept of interface as process, suggesting that the interface only exists in the process of contact. Like Kopenick and Eckmann, his theory begins with an articulation of the interface as a zone of contact. This is not a seamless union or bridge. Rather, the interface is the "generative friction" in this contact (Galloway 2012: 31). He suggests that the difference between layers, and between layers and interface, are never easily discernible. For example, in a web page, there is little to distinguish between the ASCII characters displayed on the page and those that are used in the markup language to produce that display (2012: 33). The interface as process is:

> [T]hat moment where one significant material is understood as distinct from another significant material. In other words, an interface is not a thing, an interface is always an effect. It is always a process or a translation . . . a fertile nexus.
>
> (Galloway 2012: 33)

This reframing of the interface from a thing, with a stable identity, to an effect, always in process, allows us to account for the material conditions in which different bodies result in different body-dress-technology assemblages.

Consider various performances of *Tap and Touch Cinema.* In images of a 1968 performance, EXPORT is not wearing a shirt; her bare arms extend out from the television box and her abdomen is visible. Her long blonde hair is teased in a style reminiscent of Brigitte Bardot (Museum of Modern Art n.d. a). In images from a 1969 performance, EXPORT is wearing a long-sleeved sweater, and her hair is styled in a more conservative manner (Museum of Modern Art n.d. b). This second performance, in which EXPORT is less exposed and dressed more conservatively, invites the viewer to experience a slightly different mediated body. These images from two separate performances provide us with a representation of different iterations of a dress-body-technology assemblage that is never stabilized. In the wearable technology interface, that fertile nexus of distinction has implications for issues of embodiment and subjectivity.

These implications arise out of both dress and technology. After first establishing that the body is "always and everywhere culturally interpreted" (Entwistle 2000: 13), Entwistle describes dress as "situated bodily practice" for a body that is the "active and perceptive vehicle of being" (29). In other words, dress is a situated practice that impacts embodiment. In *Technologies of the Gendered Body*, Balsamo argues for the role of technology in materially redesigning the body. She describes the techno-body as a "boundary concept" in an ideological tug-of-war between the organic/natural and the technological/cultural (1996: 5). The body can no

longer be understood as having any originary, natural state. Instead, the organic can only ever be known in relation to the culturally produced body that is increasingly framed through technology in the second half of the twentieth century. Neither wholly technological nor wholly organic, the techno-body is both at once. Though Balsamo's work refers mostly to analog forms of technology, her concept of the techno-body articulates a perspective that, if anything, becomes more urgent in an era of emerging wearable technologies and ubiquitous mobile computing. This is particularly true of her assertion that "[n]ew body technologies are often promoted and rationalized as life-enhancing and even lifesaving. Often obscured are the disciplining and surveillant consequences of these technologies—in short, the biopolitics of technological formations" (Balsamo 1996: 5). I will return to this critique later, but for now it suffices to establish the concerns of wearable media as growing out of the wider milieu of the techno-body.

None of these theories can be reduced to suggesting that dress or technology simply translates the perceptions of the body into a projection of self. The process is more complex than that. Grosz suggests that the "body must be psychically constituted in order for the subject to acquire a sense of its place in the world and in connection with others," while at the same time, "social inscriptions of bodies produce the effects of depth" (1994: xii–xiii). In other words, the body is in a mutually constitutive relationship with a socially situated self. Grosz uses the metaphor of a Möbius strip to describe the relationship between inside and out in terms of embodied subjectivity. The relationship between body, dress, and self involves both performance and inscription. For instance, in Ryan's concept of "dress acts," to wear a garment is to perform signification, to situate a body within a historically specific system of signification in a particular cultural location. At the same time, a body is never a blank canvas onto which signification is draped. Bodies are never outside of culture. They are always inscribed by the social. Thus, a body that is dressed is already marked by gender, race, class, and other manifestations of subjectivity. Further, these bodies are also inscribed by the norms that arise out of legislation, medicine, and other institutions (Grosz 1994: 142). Our sense of the body arises from the material and social inscriptions upon it, and our sense of the self is simultaneously imbricated with this social body.

The dress-body-technology assemblage of wearable technology functions as a fertile nexus not just between user and computing device, but between the fashioned, technological, and embodied subject. This subject is often theorized as a cyborg being. It is important to consider the connection between the fertile nexus of the wearable tech interface and theorizations of the radical potential of the cyborg subject. In "A Cyborg Manifesto," Donna Haraway suggests that the figure of the cyborg presents an opportunity: "a cyborg world might be about lived social and bodily realities in which people are not afraid of their joint kinship with animals and machines, not afraid of permanently partial identities and contradictory standpoints" (1991: 154). The cyborg for Haraway is a potential means of resisting the "informatics of domination," the material and ideological shift to hierarchies and power structures grounded in networks, technological virtuosity, and biopolitics, enacted through global capitalist culture (1991: 162). As a fertile nexus of bodies, machines, and inscriptive practices of dress, wearable technology presents one means through which a material enactment of a cyborg assemblage has radical possibility.

Kathleen McDermott's Urban Armor collection is a series of wearable garments in which we glimpse the cyborg's radical possibility. Of particular note is the "Personal Space Dress"; its skirt expands when activated by a proximity sensor in order to protect the wearer from unwanted contact (Taylor 2014). The choice of a feminine garment—a dress—calls attention to the way women in particular are subject to harassment in public spaces. McDermott's use

of pink and white lace signifies a high degree of girlishness, akin to "sweet lolita," a Japanese street fashion subculture. Interpretations of lolita vary. For Winge (2008) and others, lolita style challenges Japanese gender norms by demanding the gaze through the spectacle of dress, while remaining untouchable behind the facade of doll-like subjectivity (2008: 60). McDermott's garment employs the same tension: it demands the gaze by invoking lolita style as it also refutes touch through sensors and motors. It emphasizes bodily presence and foregrounds the importance of touch by denying it through surrogate technological agency. It is no accident that McDermott's demo video occurs on a train. Though it was filmed in Hong Kong, the invocation of Japanese street fashion filmed on public transit undoubtedly makes reference to issues of harassment on public transport in Japan that have received significant recent news coverage. Here we have an assemblage of dress (lolita style), body (the body of model Annick Lung), and technology (proximity-activated motors) that signals kinship and affinity among women who experience public harassment across cultures, while drawing particular attention to the issues faced by young women on public transport in Japan. While not unproblematic, the Personal Space Dress does operate through the zone of contact in a body-dress-technology assemblage that evokes cyborg subjectivity as a challenge to oppressive gender regimes.

Most wearable technology, however, does little to realize its cyborg potential. The most ubiquitous wearable technology today is the fitness tracker. It generally comes in the form of an arm or wristband that explicitly marks the wearer as a techno-body. The sleek gadget features dark colors and silver metallic touches, though an increasing number of devices and accessories are being developed for an audience who would prefer more fashion-oriented aesthetics. The wearer is no longer limited to only a geek-chic or fitness aesthetic and may align the device with a wider range of dress choices. Though the device itself may be screenless, it is functionally inseparable from the interface of a mobile or web application that offers a more complete perspective on the wearer's data. The devices often include a vibration motor or speaker to offer status notifications through tactile or auditory signals, thus augmenting its integration with the body's kinesthetic and sensory capabilities.

No description of the fitness tracker would be complete without attention to the body that forms part of the wearable technology assemblage. The device marks the techno-body as one that is interested in health and/or understanding the self. But the interface between dress-body-technology is also shaped by the gender, race, class status, and relative fitness of the wearer. Consider, for instance, how interpretations of fitness trackers may morph in relation to norms regarding which bodies are constructed as already "fit" versus those that are othered in some way, via age, gender, race, or ability. The device interfaces with the body on which it is worn and inscribes a relationship to "fitness," but the body also inscribes the device itself in terms of its status as an effective management tool, laudable aspiration, or useless accessory. In other words, the device is affected by the bodily presence of the specific body on which it is worn. The interface can never be actualized before the device is worn. Once the device is donned, the assemblage of dress-body-technology begins to enact the ongoing process of interface effect. The interface is activated as a process in the zone of contact between dress, body, and technology.

As I mentioned earlier, Grosz suggests that, in the process of inscription, "[the body is] made amenable to the prevailing exigencies of power" (1994: 142). The fitness tracker hearkens back to Balsamo's warning about technologies that contribute to the "biopolitics of technological formations" and to Haraway's "informatics of domination." Intended to manage the behavior of a population, the device produces data that has clear personal privacy implications and is a latent tool of legislative inscription—data from trackers has been used

in various legal proceedings, for instance (Crawford 2014). In addition, the fitness tracker inscribes a techno-body as narrowly self-focused. The logic underlying this device is that more data is needed for a better self. The narrative of this feedback loop between data and self (i.e., the Quantified Self) creates a myopic focus on self-determination and supports fantasies of meritocracy. If one can just understand one's data and act upon that understanding, one can improve oneself. If one cannot, then it is a failure of inadequate data, poor understanding, or a lack of will, but never a failure of neoliberal self-determination.

Balsamo notes, "whatever label they attract, the cyborg serves not only as the social figure of the mass-mediated popular culture of American techno-science, but also as the figuration of posthuman identity in postmodernity" (1996: 18). The posthuman is a term with various meanings, though in this case Balsamo is referring to technological embodiment. In this model of the cyborg as posthuman identity, Haraway's potential kinship and affinity is suppressed in favor of the neoliberal subject who values personal responsibility above collectivity (see Barnard Center for Women 2013). As the most ubiquitous current form of wearable technology, the fitness tracker presents a rather bleak landscape.

In imagining alternative landscapes, one wonders what the Quantified Other or the Quantified Self-in-Kinship might look like. In other words, how does the dress-body-technology assemblage shift when it is widened to account for the self as an already-social self? How can the dress-body-technology interface refuse the neoliberal biopolitics of technological formations? These questions might be the impetus for subaltern counterpublics that emerge in response to the neoliberal norms of current wearable technology. Nancy Fraser defines subaltern counterpublics as "parallel discursive arenas where members of subordinated social groups invent and circulate counter discourses, which in turn permit them to formulate oppositional interpretations of their identities, interests, and needs" (1990: 67). For instance, Mothership HackerMoms is a makerspace whose membership is open only to women with children. The organization provides a physical and discursive space in which the particular needs and priorities of maker moms can be formulated into discourses counter to those of dominant maker culture.

Dunne and Raby argue that critical design can be one means of articulating counter-discourses. They assert that everyday objects can be designed to articulate social and ethical issues in ways that are more accessible to the public than government research, which is often linguistically and philosophically opaque; art, which often remains in sterile gallery settings; and, film and literature, which may be relegated to the realm of fantasy (2005). These "products" (i.e., objects that are embedded in our everyday material culture) can be designed in such a way that they resist or challenge oppressive norms. Dunne and Raby cite Tobie Kerridge, Nikki Stott, and Ian Thompson's "Biojewellery" project, which uses bits of human bone to grow the material to make engagement rings, which are already potent cultural symbols. By incorporating organic matter into the engagement ring, Biojewellery challenges norms of what can be commodified and the transactional nature of courtship and marriage rituals.

Material end-products are not the only way in which design can contribute to counter-public formation. DiSalvo emphasizes the processes of public formation, which may be prompted by the design of objects using the tactics of projection and tracing. In projection, objects are designed to project possible outcomes of current scientific or technological scenarios (2009: 55). In tracing, design objects guide users to uncover the histories and/or current infrastructures of existing scenarios (57). In both cases, the impact of design tactics are found less in the finished product and more in the processes of discovery that they prompt, and these processes may lead to the articulation of a public (59). There are many artists and

designers who are engaging with discovery, articulation, and critical design in their material practices (see Quinn 2002; Ryan 2014).

For the remainder of this chapter, I focus on how the university classroom might also be a space in which such questions are addressed and counterpublics are articulated. I approach Fashioning Circuits (see Figure 19.1), a public humanities project that coordinates research, university coursework, and community workshops, from this perspective. The university courses for Fashioning Circuits are taught from within a humanities framework, and they are intended to be inviting and supportive to populations, namely women and underrepresented people of color, who are marginalized in typical computer science spaces. From the very outset of the courses, the goal has been to articulate a counterpublic to dominant computing publics by creating a space in which women and underrepresented people of color feel comfortable learning and have the freedom to pursue projects that reflect their priorities and needs. Depending on whether Fashioning Circuits is taught via independent study or formal coursework, the gender ratio varies from 50 percent to 100 percent of students identifying as women. The ratio of students of color is anywhere from 30 percent to 50 percent people of color, which is much higher than dominant computing publics, such as those of computer science degree programs or Silicon Valley tech companies.

In addition to engaging this audience, there are two foundational approaches that help challenge norms and articulate counterpublics. The first is the reading list. The dress-body-technology assemblage is a given in Fashioning Circuits and serves as the organizing logic for theoretical readings. The students are mostly upper division students in Critical Media Studies. I can reasonably assume that they are already versed in the social considerations of technology and that they will bring that experience to the classroom. So I assign course readings that address issues such as the role of clothing in the performance of gendered, raced, classed, and sexual identities; cultural appropriation; respectability politics and the policing of bodies; and the ethics of consumption and global labor practices. These form a foundation before we move on to readings that more explicitly address wearable technology. The students also establish a grounding in intersectional feminist epistemologies and learn to consider how networked bodies are not just connected in technical networks, but also in networks of global flows of capital, production, and consumption. By emphasizing social construction, systemic power, and intersectional identities, the reading list is constructed to highlight the fault lines in the notion of the neoliberal subject.

Ratto describes the "review of relevant literature and compilation of useful concepts and theories" as one of the stages of critical making (2011: 253). In this case, the relevant literature and useful concepts are connected to wearable technology as a dress-body-technology assemblage. This connection influences the second foundational tactic of Fashioning Circuits: critical making. Critical making is a multivalent means of incorporating the body of the student into Fashioning Circuits. As a collective, the classroom tends to be a much more diverse space than dominant computing publics. Students are more likely to be engaged in creating alongside others like themselves than they would otherwise. The makings of a counterpublic are initiated in the embodiment of the students, who bring with them situated knowledge. Drawing on Papert and other theorists of constructionism, Ratto suggests that critical making has value in "connecting the sensorimotor 'body knowledge' of a learner to more abstract understandings" (2011: 254). Students bring or develop new embodied epistemologies in the acts of sewing, coding, and electronics work. Challenging gender binaries, every student engages in work that has been traditionally viewed as hypermasculine and that which is coded as hyperfeminine, often at the same time. Circuit boards and microcontrollers are paired with fabric and conductive thread, resisting the dichotomies of gendered labor.

Figure 19.1 A Fashioning Circuits community workshop participant handsews a Lilypad Arduino and LEDs.

The assignment structure and classroom practices are intended to reinforce thinking beyond dominant paradigms of wearable technology. For the final project, students are required to conceptualize and produce something that makes a statement or solves a social problem. Shared classroom practices are an important factor in these projects. Significant amounts of class time are devoted to workshops where students can engage in "doing it with others" (DIWO). Workshops address various topics, such as an introduction to the sewing machine and fabric tools or collecting analog data from environmental sensors. The DIWO model is supportive of affinity-building, but also of the individual needs of students for troubleshooting and problem-solving. In addition, many of the hardware, software, and tutorials we use are open source materials. Kinship and affinity are created as part of a collective where we consistently enact Pierre Lévy's knowledge space, in which "nobody knows everything, everyone knows something" (1997: 14). This destabilizes self-reliant and self-determining notions of neoliberal subjectivity and instead emphasizes the strength and value in our interdependence. The classroom becomes the grounds for counterpublic formation (i.e., a space for the enactment of the shared values of reciprocity and inclusivity in opposition to the informatics of domination that privilege masculinized communication and individual virtuosity).

The classroom is undoubtedly a space of social inscription. In Fashioning Circuits, students are enacting their own inscriptions of dress and adornment in creating their own wearable objects. In addition, the theoretical readings and emphasis on embodied knowledge are often an early, or even a first, exposure to learning in a feminist framework. On occasion, students whom I describe as "feminist sleeper agents" have their curiosity ignited by the course and are awakened to a more active engagement with issues of intersectional feminism. The course

itself is an interface effect, where feminist epistemologies and critical making meet in a zone of contact that projects alternate realities in which kinship and affinity are privileged and the needs and viewpoints of marginalized or underrepresented groups are prioritized.

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