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Wearable Augmentations: Imaginaries of the Informed Body

Ana Viseu and Lucy Suchman

Introduction

Almost all Marquesan art was attached to the human body (e.g., tattooing, adornment). Moreover, the art that was not intrinsically part of the human body (e.g., weapons, canoes, furnishings of houses, etc.) was conceptually treated as if it were. Thus, a chief's canoe was part of his body, had a personal name which was one of his own set of names, if injury was done to it, injury was done to him, and so on.

Alfred Gell (1998: 168)

The intimate and meaningful association between persons, bodies and artefacts is a recurring theme across anthropological accounts, from classic ethnographic texts to contemporary discussions of art, agency and material culture.[1] In his explorations of the agential power of artefacts, Alfred Gell emphasises through myriad examples the constructed and contingent nature of the boundaries between persons and things. Such human–artefact relations, moreover, form part of a

repertoire of strategic resources through which one person's body, or a collective of bodies, can engender specific effects in others. So tattooing, as one example, works simultaneously as a form of bodily protection, affiliation and differentiation. Whether for purposes of seduction or intimidation, artefactually augmented bodies are fundamental constituents of social agency. At the same time, Gell shares with Strathern (1999) an interest in the distributed nature of agency, as actions and effects are understood not as expressions of individual will but an outcome of mediated, social and material practices. The person is not isomorphic with the spatio-temporal coordinates of the body, on this view, but is effectively made up of 'a spread of biographical events and memories of events, and a dispersed category of material objects, traces, and leavings, which can be attributed to a person and which, in aggregate, testify to agency' (Gell 1998: 222).

In the context of twenty-first-century technoscience and its commercial partnerships, these observations take on a new salience in the case of so-called 'wearable' technologies. Recent years have witnessed an increase in the number of research and development (R&D) projects carried out under the banner of augmentation, of both body and environment. Augmentation is understood to imply the coupling of humans with computational devices, taken to extend the body's native capacities through information processing. Wearable personal technologies are a primary form of augmentation, intended not only to extend and enhance the body technologically but to treat the body as a kind of intimate host giving rise, at least in theory, to a symbiotic relationship between person and device. The growing commercial importance of augmentation is reflected in the

increasing number of technologies that are designed to be used in synergy with the body. These include ‘smart’ running shoes (Associated Press 2004), armbands that monitor sleep (Wysocki 2001) and shirts that monitor heart attacks by sensing the body’s heartbeat (Nowland 2003).

Despite the increasing number of companies and research laboratories devoted to developing wearable computers, little research has been done on the cultural imaginaries that inspire their design. Our aim in this paper is to explore the question of what familiar and emergent theories of the body – and of personhood – designers and engineers are drawing from and inscribing into these sociotechnical artefacts. We explore this question through the analysis of empirical materials generated in the course of an ethnographic study of the design and implementation of wearable computers (Viseu 2005). More specifically, this paper is drawn from interviews conducted with wearable application developers working in the four main areas of wearable research: work, leisure, medicine and the military. We begin by briefly introducing the concept of wearable computers, then turn to the four cases that constitute the bulk of the paper. Interviews done with developers in the area of work applications are extended through an ethnographic study of the implementation of one particular wearable vision, a pilot augmentation of telephone service technicians working for a major Canadian provider. We close with a reflection on the types of subjects, objects and entities that are in evidence in these initiatives.

Among the various implications of wearable technologies that we might trace out, our focus here is on one issue in particular, resonant with others in this

volume. That is the question of relations of self, embodiment and knowing in the context of a cultural imaginary dominated by the trope of 'information'. We share with Dumit an interest in the ways in which certain commercial interests – pharmaceutical companies in the cases that he considers, technology vendors in those investigated here – assume the figure of a body that continually emits signs inaccessible without technological mediation. Rather than further articulating the body/technology interface (Latour 2004), however, we argue that the wearable within the imaginaries evidenced here drives a further wedge into the gap dividing the modern body from the knowing and acting self. Sold as technological solutions to this epistemological lacuna, wearable augmentations promise to enhance the legibility of bodily signs. At the same time, however, the greater visibility of bodily information implies an associated responsibility to act, and more specifically to act within intensified regimes of self improvement and bodily control.

Wearable Computers

Precisely what a wearable computer is, or should be, is a topic of debate among researchers and developers themselves. A key issue in this discussion is whether to include or exclude technologies such as mobile phones, or personal digital assistants (PDAs) in the wearable computing category. Their exclusion, when advocated, is justified on grounds that these devices do not adequately meet the 'always on, always ready, always accessible' (Mann 1998) criterion for wearable computing. What is at stake in these discussions is the identity not only of the

technologies but of the field of wearable computing itself, and the latter's viability as a unique area of scientific research. For our purposes here, however, it is less crucial to delineate the boundaries of the field than to identify objectives common to research and development efforts that affiliate with the wearable project. The latter are indicated in one definition offered by prominent researchers in the field; that is, a wearable computer is a 'fully functional, self-powered, self-contained computer that is worn on the body [… and] provides access to information, and interaction with information, anywhere and at anytime' (Barfield and Caudell 2001: 6; see also Mann 1996, 1997; Bass et al. 1997; Barfield and Baird 1998). The aim, in other words, is to create devices that are intimately tied to the body, autonomously functioning *and* perfectly interconnected. In this respect wearable computers materialize and make visible values characteristic of contemporary Western societies since the mid-twentieth century, including a desire for mobility, combined with continuous connectivity, personalization and control. The leading ambition of wearable computer developers and their imagined users is that of personal empowerment: wearable computers are the path to the augmentation of human motor, sensory and cognitive abilities (Barfield and Caudell 2001; Mann 1998; Pentland 2001). Underlying this vision is the assumption that, as Barfield and Caudell (2001: 5) put it, 'our senses are still limited in a number of ways,' and that this deficiency requires remedy through computational and informational upgrading.

If the actual development and implementation of wearable computers over the past decade has been slow, the dreams behind them have only become more

ambitious. While initially wearable computers were considered tools designed to give wearers instantaneous and constant access to information, more recently the goal has become to make them proactive, that is, responsive, networked and 'aware' (Clarkson et al. 2002; Mann 1997; Barfield and Caudell 2001; Smailagic 2003). This shift implies much more than technical advances: it implies a shift in the wearable computer's identity. No longer simply a tool, the wearable computer becomes a 'second brain', 'a technological companion', 'an extension of the self' or a 'second skin' that is connected to its owner in intimate, synergistic or symbiotic relationship (Mann and Niedzviecki 2001). In the future, we are told, a wearable will know its user better than she knows herself, being able to act preemptively on her behalf (Wood 2002; Viseu 2003a). Although figuring more in the realm of imagination than implementation, these concepts are key to understanding the design of wearable computers as at once a rhetorical and a technical project.

The figure of the wearable as a second brain or skin is closely tied to the wearable's imagined sentience or awareness. 'Awareness' in this context is meant to signify a computing device that can recognize, adapt and (re)act to its wearer, its location and the activity being performed. In technical terms, awareness is built through the development and incorporation of sensors such as infrared, accelerometers, temperature sensors and biological indexes. These sensors extract analogue stimuli from the body or environment and convert them into electrical signals that can be interpreted by a digital device with a microprocessor (Barfield and Caudell 2001). This information can be processed locally to perform 'context

aware' tasks such as navigation and communication; or remotely, when the information is processed by a third party, for example when monitoring cardiovascular activity. In the latter case the wearer does not need to initiate the process of transmitting information, and consequently does not need to be conscious that information is being transmitted. Awareness then can be interpreted as a means to make the wearer visible and readable, whether to herself or to others.

Awareness is also a harbinger of intelligence: in its implied combination of information processing abilities and communication/networking capabilities, awareness is deemed to give the wearable computer its 'smart' status. The scenario below is indicative:

> A full-fledged personal computer network woven into an individual's clothing, [the wearable computer] will learn the preferences of its owner by watching behaviour and taking note of habits. It will manage a personal datebook and know where its owner should be even before departure. And by preemptively scouring Web sites, it will constantly be updating the best way to tackle the next task. Suppose a beach party is on the schedule. [The wearable computer] will know this because the event is in the calendar and there's a note on a to-do list that says, for example: Pick up beer. When the system observes its owner getting on a bike, it immediately seeks the best directions to the party by way of a packaged goods store – taking into account that its owner hates heavy traffic. After calculating all of this

> information, [the wearable] displays a map to the beach on the owner's glasses without even being asked. (Wood 2002)

These notions of awareness and 'smartness' translate differently in the four areas of wearable computing considered here:

1. The stated goal of wearable **work** applications is to improve efficiency and productivity by providing hands-free manipulation of information and access 'on the go'. Usually targeted at mobile workers, particularly those who perform their work outdoors, wearables have been hailed as the 'killer application' that will increase productivity and provide quick returns on shareholder investment (Sakurai 2002). Mobility in this context refers not only to workers but to information as well. Being able to access information 'anytime-anywhere' means that workers may be accessed in turn. Moreover, their visibility to the system effectively renders them informational, as the indicators of their work activity increasingly come to stand for them.

2. Developed for mundane activities such as music playing, and imagined in terms of ambitious goals such as experience or memory recording, wearables for **leisure** applications have also been described as (yet another) 'killer app' that will turn wearable computers into everyday apparel (Post and Orth 1997; Barfield and Caudell 2001; Barfield et al. 2001). Augmentation through leisure or life-style wearable applications poses issues similar to the ones mentioned above, yet here the benefits of increased machine awareness are equated not with improved

health, efficiency or effectiveness but with increased human pleasure and, in a sense, with increased 'humanness'.

3. Most **health** applications are devised to capture continuously, measure and interpret body-related information that would otherwise be concealed or go undetected. The relationship between the computing device and the body is imagined as a synergistic feedback loop with both entities transmitting and receiving information and acting upon one another's signals. The expectation is that after being processed and analysed by the wearable (or a third party) the information can be re-introduced to the individual from whose body it was retrieved to be interpreted by a computing device (biological or silicon based), producing effects that can range from increased awareness to behaviour change, or more crucial interventions. As we shall see, such applications give rise to notions of augmented self-awareness and self-surveillance. However, they also pose questions of control and disempowerment, which are all the more important given the sensitive nature of health related information.

4. **Military and security** applications generally have as their goal the augmentation of the soldier's physical and cognitive abilities. They are part of a suite of technologies being adopted by the military 'to provide full-spectrum dominance through achievement of information superiority' (Gentry 2002: 90; see also Machamer 1995). The augmented soldier is seen as a fully integrated information network, the central issue being to establish a balance between visibility and invisibility, access and control in military operations. How much information, for example, should individual soldiers be given without causing

information overload, or a problematic degree of self-sufficiency? What is missed in informational or mechanistic representations of the body and of the battlefield? These brief characterizations introduce some of the issues that define the four major application areas for which wearable computers are currently being developed. In what follows we draw from material generated through interviews and ethnographic engagement to describe in more detail the relationship between wearable technologies and the bodies they aim to construct.[2]

Sonica: Wearables at Work

We begin with the case of a company we call Sonica, developing wearables for work.[3] The case of wearables at work evidences the ambiguous politics of the dream of mobility with connection. The wearer imagined by enthusiasts like University of Toronto's Professor Steve Mann (Mann 1997; Mann and Niedzviecki 2001), or pictured in media representations of the upwardly mobile professional, is quite different from the one figured in projects financed by corporate investors concerned with a mobile workforce. While mobile phones, notebook computers and the like may be aimed at traditional 'white-collar' workers in areas such as management or sales, the prototypical wearable user in the imagination of industrial producers is one who is mobile and needs fast and reliable access to information, while having their 'hands free'. This rationale is readily acknowledged by Victor, national sales and marketing manager for Sonica, a hardware manufacturer interested in developing a market for wearable products, who says:

> In our space a lot of the technicians, field service users, need to have their hands free to be working in an environment where they can do multiple tasks, and the PC just wasn't usable when you would have it on a shoulder or perhaps in the vehicle only. By putting a strap around a small screen, the user could have access to a lot of information and do communication in real time.

While the media feature products that feed on popular images such as those exemplified in Paul Verhoeven's 1987 movie *RoboCop*, picturing individuals equipped with head-mounted-displays, a keyboard on their wrist, and sleek, almost-invisible computers attached to their bodies, existing implementations of wearable technologies evidence different and more practical concerns (see Figure 1).

FIGURE 1 HERE

Figure 1: Bell service technician, 2002 (Photo by Ana Viseu)

The product developed by Sonica, for instance, is part of its 'toughbook' division, that is, it is constructed to withstand inadvertent dropping, rain, cold, dust and other forms of harsh treatment. It is a distributed computing device composed of

two parts: the CPU and the touch-screen display. A third, optional component, the docking station, offers added functionality to the CPU, but remains chained to a desk (see Figure 2).

FIGURE 2 HERE

Figure 2: Sonica's wearable computer (Photo by Ana Viseu)

Victor imagines a user in need of 'a rugged wearable solution' to the competing demands of mobility and connection. This is an outdoor body, exceeding the bounds of the office and threatening to lose contact and disappear from view. To do the work requires that workers both travel out from the central office and, crucially, report back to it. And while information may be weightless, its production and use by an embodied worker requires a means of entering and accessing it. However small and powerful the 'central' processor, the writing and reading of information requires keyboards and displays sized to hands and eyes. The ability and willingness of mobile workers to encumber themselves – the embodied weight of information – limits its wearability. As Victor explains:

> [E]very customer we went to, we said 'Here's an interesting solution. What would your application look like on this?' … We took the product to [a large telecommunications customer] ... and the first thing I asked the project team there was 'What would your application look like on this?' They said 'Give us a unit, load it, and we'll take a look.' And their immediate feedback was

> ‘No, it doesn’t work for us. Our application requires someone in their truck typing a report.’

On this account the truck serves as a mobile environment, a site midway between outdoors and indoors, the mobile body and the stable centre of the office. Mobility from the point of view of the central office interested in receiving a report is less about autonomous movement, and more about the worker as mobile agent acting on another’s behalf. For Sonica, however, the truck is not only an intermediary between the mobile worker and the office, but an interim step along the way to the full realization of wearability. Victor continues:

> What we were trying to eliminate was this movement between the truck and the job site, back and forth to get new information, or to communicate other information. Often you would see a technician with a cigarette package writing down numbers, nodes and various numbers for fixing a repair. We wanted it all on that tablet.

The ‘cigarette package’, as it turns out, was a recurring figure in stories of current working practices. In Viseu’s travels with technicians from a major telecommunications company, conducted as part of an ethnography of the deployment of wearable computers, she did see technicians reach into their back pockets for a small piece of paper, onto which they wrote things as they performed a given task. And technicians did smoke, at a rate that was striking

relative to the larger population within Canada. But she never saw a technician use a cigarette package as a notepad, which raises the question: Just what gives the cigarette pack example its mobility as a story? At least part of the answer, one suspects, circles back to the figure of the technician mentioned earlier. Imagined as a manual labourer, however professional, the wearable user is, not surprisingly, gendered as male and, like the solution that he requires, 'rugged'. The phrase 'often you would see' in the quote from Victor, combined with the urban legend quality of the cigarette pack example, signals a frequent feature of stories like Victor's; that is, while framed as eyewitness accounts of the present, their status as either real or imagined remains unclear. Similarly, reports of field trials in the use of wearables among technicians are characterized by conflicting accounts of incorporation and/or resistance. Victor imagined that:

> people out there who are doing day-to-day tasks that don't require a lot of inputting through a keyboard … love the technology. They love being able to have it on their hip, take … their notes, detailed notes, and make some additional comments and finish a report and upload to a wireless network.

This account contrasted sharply, however, with Viseu's own observations of technicians' concerted resistance – what Victor himself acknowledged as 'the limited buy-in from the field', and the 'pushback from users who felt that this was a productivity tool'. The latter is hardly surprising insofar as the technology was presented to technicians as a way to streamline the work process and thereby

increase productivity, efficiency and, possibly, their own salaries – though without mention of the consequent changes to their workflow, power relationships and autonomy, or of a likely reduction in the workforce. As technicians became acquainted with the technology they came to see it not as a device that enabled them to do their job more easily or effectively, but as one that effected such significant transformations to their work that it implied a new job and by, extension, different workers. Using a number of strategies, active and passive, discursive and practical, they resisted these transformations to their personal and professional identities.

The case of wearables at work makes visible some contradictions built in to the wearable project. While wearables are depicted in the media as sophisticated devices for equally sophisticated, white-collar men, they are being produced for (and used by) blue-collar workers. Moreover, while wearables are publicized as materializations of mobility, thanks to informational connectivity, there is an enduring and unresolved tension built into their actual implementation, between autonomy and control. Equipped with a wearable computer, the user's (male rugged) body is brought up to speed with the requirements of the electronic workplace, one that demands constant access by and to information. It is an efficient and effective body. Equally important, however, this is no longer a body out of reach with a potential to break loose, but rather a body whose 'data shadow' (Clarke 1994) is, at least in theory, always visible. This may help to explain why Sonica's representative states that equipping a field worker with a wearable computer with wireless connectivity creates a new worker, or at least,

allows managers to 'think of the worker [in a] completely different [way]'. And it may help to explain workers' resistance to becoming 'wired' as well.

I-Wear: Wearables at Play

The I-Wear initiative is part of the I-Lab project, described on its own website as a 'deep future research lab' that does not engage in the actual manufacture of any products but focuses instead on imagining what these products will be and how they might work. At the height of its growth the I-Lab had campuses in two major European cities, and was, according to its website, 'the home and playground of 70 original[4] [sic] scientists from 28 countries'. In late 1999 I-Lab launched I-Wear, described in press releases as an initiative that 'wants you to be able to wear your office, your gym, your medical clinic, the Department of the Environment and a policeman—and still travel light'. Two years later I-Lab went bankrupt.

I-Wear's central research focus was intelligent clothing, wearable technologies imagined as a 'second skin' but one that acts as well as a kind of 'second brain' for the wearer. As I-Wear's Research Director explains:

> I got interested in wearables, because wearable computing, the way I saw it, is like adding a second brain to a robot's body, which in this case is the real body, our body. It was interesting to try to find ways in which to couple the control which happens in the brain with the control that would happen in that

> wearable: to see how that wearable could start influencing the behavior of people.

In a familiar modernist move, brain and body here are decoupled, as both become available for computational upgrading. The project of the augmented human and the humanlike machine trade places, however, as technologies imagined as robotic enhancements are returned to the 'real body, our body'. The case for the wearable posits not only a mind separated from its body, moreover, but also a body separated from its skin, all in need of technological reconnection. The idea of a 'configurable [or functionalizable] second skin', epitomizes I-Wear's vision:

> [The second skin] can be decompos[ed] in different resources [the power, display and sensor layers], that you can dynamically compose into particular functionalities, that is the first pillar. And the second one, is that this second skin has this awareness of self, environment and activity. And then the two pillars come together … [and] you can exploit that awareness to dynamically configure the functionality out of those resources embedded in the different layers of the second skin.

The skin here becomes not an integral materiality of embodied being, nor even a boundary between being and the world, but a kind of 'second self' in a more literal way than that described by Sherry Turkle in the 1980s (1984). Mind, body and skin, moreover, are together alienated from a surrounding 'world', commonly

figured in terms of ordinary objects and physical environments, which is itself in need of greater 'awareness' in order to be able to configure itself in a more accommodating way (see Chasin 1995; Suchman 2007, ch. 12). As I-Wear's Research Director explains:

> The essence of wearable computing is that the computer that you wear, that thing you wear, shares the same contexts as the ones in which you find yourself … [a wearable computer] is something that is always on, is always trying to be of service, trying to help, and it does that so that it links into your needs because it understands the context in which you find yourself: it understands what you are doing, it understands in what kind of environment you are, it understands what your needs may be, it understands your emotional state.

Awareness in the service of subservience is a recurring dream for wearable computing, repeatedly mentioned in the wearable literature, both popular and scientific. Coupled with its imagined 'pro-activity' on the user's behalf, the aware wearable emerges as an intelligent, sentient companion. The Director continues:

> I think potentially [a second skin] can make us more aware of ourselves. … It's not only the form of things that are going on, the external appearance of things by which we will be able to look at ourselves but also, at the blink of

> an eye, we will able to see much more about ourselves … So, I think it will give us a more complete image about who and what we are.

I-Wear's Research Director readily acknowledges that this merger of 'skins' and 'brains' is not without consequences. As 'new way[s] of connecting with our bodies, and with the world', wearable computers open the door to problems of control. I-Wear's Research Director explains,

> It's a whole category of interfaces that I call 'behaviour bias interfaces'. Those are interfaces that will [do] just as the name says, they will bias [the user's] behaviour. It is a bit what marketing people are doing too. You are not always conscious about the way marketing influences your consuming behaviour.

The issue here is similar to that raised in Dumit's discussion (this volume) of the ways in which direct-to-consumer psycho-pharmaceutical marketing strategies help to create and normalize selves in continuous need of new, self-enhancing products, a theme to which we return in the case of wearables for health.

Together, the Director imagines, smart clothing and intelligent environments can even eliminate the need to relive one's experience imaginatively, or recount it to others. Embodied activity can be transformed into a landscape of measurable elements, a 'signature of the experience', that can be captured and re-run as a kind of restored memory package, transmittable in turn to

others. I-Wear's Director is not alone in perceiving embodied experience as a play in which the roles of actor and spectator are interchangeable. In a documentary on his cyborg experience, that places him as the main actor in his own 'reality-webcast', Mann describes a future where his grandchildren will be able to 're-experience [his] life as [he] did' by watching the reruns of his life on video (Lynch 2001).

The long-term goal of I-Wear developers is that the resulting 'smart' clothing should move from novel to normal and natural, so that it can, says the Director, be 'just [bought…] off the shelf and you don't have to worry about the fact that it's technology or not'. Like other aspects of infrastructure, I-Wear should 'disappear into the woodwork', in this case through a 'FAN' or 'fabric area network' protocol, enabling a 'deeper' integration from items of clothing, to fabrics and ultimately to the level of 'fibres themselves'. One of the issues that we face as a society, says I-Wear's Research Director, is that of whether we 'want these things or not'. We must debate the 'implications of intelligent clothing … because if [our] clothes are permanently somehow linked to the environment then there is a level of visibility, which is an information visibility and a presence visibility, [and] that will also [have an] impact on us'. Thus, he says, it is important that we discuss 'the relation[ship] between the first and the second skins'. One possible resolution may lie in technologies such as I-Wear becoming not only 'on-body' but increasingly 'in-body' devices, a process that he suggests implies 'a merger between the two'.

Infobody: Wearables for Health

InfoBody was founded in mid 1999. Like many other high-tech companies of this period, it began as a 'vision' of technological possibilities, with a commercially plausible business model coming only later. Unlike many others, however, InfoBody is still in business and actively pursuing its vision, that of creating 'continuous wearable body monitors'. InfoBody produces an armband, to be used on the upper arm, that contains a computer, memory and multiple sensors that continuously monitor certain physiological data, for instance motion, skin temperature, heart rate, evaporative heat loss and the amount of heat being dissipated by the body (see Figure 3).

FIGURE 3 HERE

Figure 3: InfoBody's armband (By permission of Infobody)

The 'unsolved problem in society' that InfoBody attempts to address, says the company's CEO, is that of 'mounting healthcare costs'. 'Most of the costs,' he explains, 'come from people's behaviours: whether they *choose* to take their medications, whether they *choose* to maintain their weight, whether they *do* the exercises that their physical therapist tells them to do, everything like that.' Care for the body on this view falls into the category of personal choice, and a responsible person will choose to monitor her body to ensure her fitness. Commensurately, failure to engage in bodily maintenance comprises a form of free-riding, leaving to public remedy that which should be the province of the responsible individual.

To reach a ‘proactive wellness society,’ according to InfoBody’s CEO, constant informational body monitoring is imperative. Moreover, with the added information extracted from her body by the InfoBody armband, the user can obtain scientifically proven self-awareness. The data extracted from the armband, the CEO explains, have been calibrated with data collected using the ‘medical gold standard’ to ensure their accuracy; that is, measures taken through proven technologies and accepted as normative references within the medical community. As InfoBody’s Chief Technology Officer puts it, ‘there is the truth and then there is our product’. Positioned as the medium through which the truth of the body is made accessible, in other words, InfoBody’s devices aim to bring physiological fact into the grasp of the experiencing subject.

The objectivity of the InfoBody armband’s measurements, InfoBody’s Chief Technology Officer suggests, raises the body’s status to that of an object worthy of the same level of care given to others. With wearables, he explains, ‘you get a new dashboard for yourself, which you don’t have before. You have it in your car, you know when you go home [and] you look at the thermostat, [you see] what temperature it is; but you don’t know what’s happening inside [your body], or what your day was like, so that’s one aspect’. No longer idiosyncratic and intangible, the body obtains a recognizable value and identity. When asked about the shifts in personal identity that might accompany such an increase in self-surveillance, InfoBody’s CEO replies:

> I think [that is] exactly what needs to happen. If people treated their bodies at least as well as they treated their cars we wouldn't be in the health care mess we are today… [W]e need to start thinking about our bodies as very delicate machines which need regular care and feeding and we have to watch over it like we watch over a manufacturing plant, like we watch over an organization we run or we watch our cars.

Joe Dumit (2003; this volume) has detailed the ways in which pharmaceutical advertising for psychotropic drugs posits a 'self' in need of rediscovery and restoration. Like the pharmaceutical body described by Dumit, the informational body is one always already at risk. At the same time, this is a body continually emitting signs, albeit in forms inaccessible to the self that might act to maintain it. The InfoBody device enables a newly informated self, recognizing and so qualified to regulate her previously alienated body. The reconnection between body and person can only be achieved through objective data, biomedical facts extracted by new technology. Hence, the company's motto, 'You can only manage what you can measure.' Encoded in the device, the 'gold standard' of the normal healthy body can be enforced and the vagaries of experientially based assessment eliminated. The augmented body is a body that reports to the self, in sum, which is thereby obligated to respond.

The Reinforced Body: Wearables in the Military

Extending human abilities, both physical and cognitive, through the use of 'on-body' technology is the objective of military-related wearable projects. In the media these efforts are usually depicted as the creation of super-enhanced, improved or amplified soldiers. For obvious reasons, this area of research has grown exponentially since the declaration of the U.S. 'war on terrorism' in 2001, and the subsequent wars in Afghanistan and Iraq.

Reinforced Body started, 'as all projects at DARPA[5] start, as hallway talk' says George, a former project manager. His colleagues and boss convinced him to pitch the idea to DARPA's director, and the project got US$50 million in funding. However, George adds that he cannot take credit for the idea, 'I believe it's one of those great problems of engineering, like the airplane, or the horseless carriage, the idea of melding man and machine. It has been around for a while, people have never been able to do it.' In the early 1960s, he recalls, the U.S. military awarded funds to General Electric to build an external protective skeleton, an exoskeleton (see Figure 4.1). At the close of the project, 'they ended up with about a fifteen hundred pound monstrosity that had a huge tether for hydraulic and electrical power'. But while the visions are old and persistent (see for instance Levidow and Robins 1989), the technological environment that informs them has changed considerably. Specifically, with the advent and ubiquity of networked information and communication technologies (ICTs) the U.S. military has adopted a model of 'network-centric warfare' that relies primarily on 'information superiority' defined as 'the capability to collect, process, and disseminate an uninterrupted

flow of information' (U.S. Department of Defense 1996, cited in Gentry 2002). This turn to information is one expression of 'the desire of contemporary martial corporeality to become intelligence incarnate' (Dillon 2003: 129).

Part of the U.S.'s network-centric warfare effort is the creation of an 'integrated soldier-centric system', a platform of which the Reinforced Body is key (see Figure 4.2 for an example of a system currently being developed). While rejecting the idea of the Reinforced Body as a 'portable power plant' that will power the electronic hardware of such a soldier-system, George explains how the Reinforced Body contributes nonetheless to its realization:

> The [Reinforced Body will] increase lethality, increase protection, increase ability to carry logistics for longer trips, and increase the mobility. You could go faster [and] longer than you could with a plain foot soldier. Couple that with increased informatics, basically, about the battlefield or your situational awareness, video monitors, infrared detectors, multi-spectrum vision. So now the soldier becomes this more complete system […]. The [Reinforced Body] is foreseen as the base of a series of technologies that we would layer on the soldier, [to] see how formidable we can make that soldier.

FIGURE 4.1 HERE	FIGURE 4.2 HERE

Figures 4.1 and 4.2: General Electric's *Hardiman* produced in 1963 (by permission of General Electric); and a full-scale mock-up of an Exoskeleton system being developed by Sarcos Research Corporation (by permission of Sarcos Research Corporation).

The following scenario, written by a subcontractor, illustrates this long-term vision.

> When Sylvia joined her military unit, she didn't realize that she was going to become faster, stronger, and smarter in a hurry. The military was training her to wear an early version of a Superman suit. Sylvia stepped into a 'soldier amplification [Reinforced Body],' which 'lifted' her weight and the weight in her backpack. As a result, she could run much faster and for much longer.
>
> With the [Reinforced Body]'s attached long arm, she could lift heavy objects that she would not normally have been able to hoist. Her smart [Reinforced Body] sensors would warn her if she was being exposed to hazardous gases or if enemy forces were nearby. Additionally, the information provided almost instantly by her wearable 'talking' computer boosted her memory, helped her solve mathematical problems, and guided her in making wise decisions. Her perceptive abilities were enhanced, too.

> She could see better in the dark and through fog and smoke, thanks to night-vision and multi-spectral goggles. (ORNL 2000)[6]

George recognizes that before this technology can be used in combat, not only do its 'kinks and bugs' have to be addressed but, equally important, it must be ensured that 'it fits into the psychology and the techniques of fighting'. In this sense, reinforced bodies are part of what George calls a 'doctrine changing technology […] a technology that is so enabling that you can actually change military doctrine'. Their deployment will require both training and new tactics that accommodate the physical and cognitive (i.e., informatics-based) augmentation of the body. Within this new regime, he imagines, the Reinforced Body soldiers may be used to spearhead ground attacks, to 'do the most dangerous and hazardous work'.

The issue of how the informational augmentation of the soldier will affect warfare was a topic of discussion in an interview conducted by Viseu with Kirk, a 'military engineering psychologist' who was involved in the development of a complementary U.S. military initiative. According to Kirk the ability to exchange 'live' information without making noise is of tremendous significance, as it is likely to enhance the safety of soldiers. However, he identifies what he takes to be a critical issue: how to distribute information among the soldiers on the ground without creating situations of information overload. Although Kirk believes that the Army's hierarchical structure will protect 'the privates, the infantry in the trenches' by sending them information on a need to know basis only, he

acknowledges that under rapidly changing conditions determining just what the soldier needs to know may itself pose a problem. Kirk points to another potential challenge as well: first-hand access to information, made possible by this computational embodiment, may lead to decision second guessing. On this subject Kirk says, 'I think that when everybody has it then there is an egalitarian kind of thing, because they all have the right to second guessing, "Dummy, why didn't he look in the computer, it's right here, it's obvious!" Given the Army's organization, with strict hierarchical chains of command meant to ensure that orders from above are followed, such a level of information transparency is feared to be dangerous, if not deadly.

George also reflects that the machine that incorporates the soldier's body, this new embodied entity, is likely to dehumanize warfare further. He likens it to the process of shooting down a plane:

> the ground soldier will have the ability to shoot from his [reinforced body] to somebody else's [reinforced body], and he may think he's maybe not so much killing the person as killing the platform. Just like a pilot shoots down another pilot. Because you know, we have these heroic ideas that the pilot bails out and all that's lost is the plane, but that is not typically the case.

While recognizing that reinforced bodies will bring about a new form of warfare that will have to be accompanied by new tactics to accommodate both the

physical and informatics-based augmentation of the body, George reiterates the place of human agency: 'The human is still pulling the triggers here…. [T]he [Reinforced Body] is still a soldier centric platform, and the soldier is still at the centre in command.' This human-centred understanding of agency is important as it distinguishes this technology from efforts in robotics and artificial intelligence. On this issue George says:

> There are people who discuss the ethics of having robots with automatic control systems, […] as the centerpiece for making decisions on killing human beings, and there are some people who have problems with that. Obviously things can go wrong, and they can kill the wrong people, but it's more than that. It's an ethical thing. It doesn't have the ability to make a judgement. The idea that we can program machines to engage in combat without humans is something that there is mixed feelings over in the military. People have funny feelings about automated killing machines.

The tension between the imperfection of the human and the amorality of the machine becomes apparent here. On one hand, technology comes to the rescue of humans, increasing their abilities; on the other, agency and its derived concepts of responsibility and accountability are still placed firmly in the hands of humans. Technology is both constitutive of the reinforced body and still just a tool.

The ambivalent agency of the reinforced body is further reflected in George's alternate accounts of bodies that disappear into the technological exo-

structures that envelop them, and their reappearance as autonomous commanders of the 'integrated soldier-centric system'. There is acknowledgement, in sum, that the merging of reinforced bodies and soldiers gives rise to a new entity that implies new tactics, intimidation and perhaps dehumanization, while agency remains the exclusive province of the human. The embodied metal creature that envelops the human body is simultaneously enabling of the super soldier, and subject to her control. But like her reinforced body, as the augmented soldier becomes more useful she herself is assumed to become more obedient as well (see Foucault 1979: 137–38; Hables Gray 1989: 57).

Conclusion

Gell has proposed that in place of recourse to some overarching cultural aesthetic or ideology, we might understand particular families of artefacts in terms of an 'inter-artefactual domain', a kind of circulating and mutually referential network of discursive and material practices (1998: 216). This leads us to reflect on the kinds of subjects, objects and hybrid entities that are imagined across the projects considered here. As at least a preliminary analysis, we would note the following as connecting assumptions. First, the 'natural' body is taken to be incomplete, falling behind the demands and potentials of the information age. The desirability of wearable augmentations presupposes the separation, if not alienation, of minds and bodies, people and things, in need as a consequence of ever more intricate reconnection. Taking human and machine as ontologically distinct, discourses of wearable augmentation reflect a continuing tension between the imperfection of

the human, and the amorality of the machine, such that one has always to provide a remedy for the other. Related to this, we find a continuing tension between passivity and proactivity in visions of the future machine – while wearable computing devices are themselves imagined as in need of greater 'awareness', they remain subservient to human needs and desires.

In this and other ways, discourses of wearable computing are responsive to, but tend also to obscure, associated agendas of visibility and control. Wearable computing incorporates – figuratively and materially – the aims of both what Foucault named 'docile bodies' and of those regimes articulated in his later writings as 'technologies of the self'. Since the eighteenth century, Foucault argues, desirable bodily forms have shifted out from qualities held to be immanent in the person to objects of bodily training such that 'the machine required can be constructed' (1979: 135). The useful body is also, and increasingly, an intelligible body, available for analysis and manipulation. In relations of labour and of service (the workplace, the military, the clinic), the aim is still the docile body, one that may be subjected, used, transformed and improved (ibid.: 136). Figured as augmentations of the self, in contrast, wearable technologies 'permit individuals to effect by their own means or with the help of others a certain number of operations on their own bodies and souls, thoughts, conduct, and way of being, so as to transform themselves in order to attain a certain state of happiness, purity, wisdom, perfection, or immorality' (Foucault 1988: 18). This is the 'elite citizen', motivated towards self-improvement and positioned as leader or manager of the rest.

Yet while the body would seem to be the focus of the projects described here, on a closer look the body, translated as information, tends to disappear – to assume the position of the node in a network, the source or repository of data, or what Paul Edwards (1996) has characterized as the 'machine in the middle' of a larger technical infrastructure. Where we locate agency in these newly augmented bodies has implications as well for what we take the person to comprise (see Suchman 2007, Lambek and Strathern 1998). The agencies articulated in anthropological accounts of bodily augmentation involve always interdependencies and contingencies. We embrace Latour's proposition 'that to have a body *is to learn to be affected*, meaning "effectuated", moved, put into motion by other entities, human or nonhuman' (2004: 205, original emphasis). Against a figure of the natural body as the ground either of knowing or of ignorance, Latour posits a dynamic body for which further mediations enable ever more refined and elaborated sensoria of difference, of body/world articulations. Similarly, the forms of embodiment explored by Scheldeman (this volume) evidence corporeal experience as the ground of knowing, but not in the form of a purified body abstracted from technological entanglements. Rather, it is precisely because the lived body is inseparable from its prosthetic extensions that what Haraway (1997) characterizes as the material-semiotic configuration of bodies and technologies comes to matter. These understandings of embodiment imply an alternate standpoint to Euro-American assumptions regarding responsible action, recasting the latter from a matter of singular acts of will or decision, to a question

of how action and its possibilities are configured, with what consequences, and for whom.

There is, we would argue, both tremendous potential and urgent need for a critical engagement with the imaginaries of wearable augmentations. Anthropological approaches orient us to the fact that intimate and meaningful relations between persons, bodies and artefacts are at once longstanding and universal, and always historically and culturally specific. Wearable computing discourses and artefacts make evident the depth to which the Cartesian split between a material body and transcendent mind or soul has sunk into Euro-American cultural imaginaries. In what Foucault names the body-object articulation '[d]iscipline defines each of the relations that the body must have with the object that it manipulates. Between them, it outlines a meticulous meshing' (1979: 152–53). The disciplinary ideals of the augmented body articulated by the proponents of wearable augmentations can in this respect be understood as the most recent materialisation of longstanding Western philosophical and political worldviews. Our effort here has been to show that while seeming to embrace the premise that '[l]anguage and materiality are fully embedded in each other' (Butler 1993: 69), the new intimacies of bodies and artefacts envisioned by wearable computing enthusiasts instead reinscribe the separation of persons and things. The augmented body as imagined by these technologists is still, in the end, a docile one, and the project remains one of enhancing its visibility, in the interests of contemporary regimes of self-improvement and control. As technologies of 'bodily permeability' (Franklin 1995) wearable computers produce culturally

specific bodily images that come to stand for the body itself, in the process acquiring normative dimensions. As such wearable computers operate to reproduce dominant discourses of personhood, at the same time that they aim to reconfigure them.

Notes

1. See, for example, Appadurai (1986), Miller (1998), Strathern (1988, 1999), Gell (1998).

2. This research was conducted by Ana Viseu in 1999–2005. See Viseu (2003a, 2003b, 2005).

3. Throughout the paper we use pseudonyms to refer both to individuals and companies. We do this not only to protect the participants' identity but also because it is not our aim to provide an evaluation of the specific products that are being developed. Rather, we want to explore the cultural imaginaries that circulate through them.

4. By 'original' we believe the authors mean 'creative' or 'innovative'.

5. The Defense Advanced Research Projects Agency.

6. The female gendering of the imagined Reinforced Body, while readable as an orientation towards inclusiveness, might also operate to invoke the figure of the woman's body as one in greater need of reinforcement.

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