Readings from
Everyware: The dawning age of ubiquitous computing

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Thesis 05 *At its most refined, everyware can be understood as information processing dissolving in behavior*

The great product designer Naoto Fukasawa speaks of "design dissolving in behavior." By this, he means interactions with designed systems so well thought out by their authors, and so effortless on the part of their users, that they effectively abscond from awareness.

The objects he is best known for - mobile phones and CD players, humidifiers and television sets, damnably few of which are available outside Japan - uniformly display this quality. His work draws much of its power from its attention to the subtle, humble, profoundly comfortable ways in which people use the world - the unconsciousness with which people hang umbrellas from a lunch counter by their handles, use notepads as impromptu drink coasters, or gaze at their reflections in a mug of coffee. There's a lot in common here with Mark Weiser's dictum that "the most profound technologies are those that disappear."

Correspondingly, we can think of everyware as information processing dissolving in behavior. This, anyway, is the ambition that I discern behind so many of the scenarios of ubiquitous and pervasive computing, from Roy Want to Don Norman: that we could claim the best of both worlds, harnessing all of the power of a densely networked environment, but refining its perceptible signs until they disappear into the things we do every day, always have done, and don't need to think about.

In this telling, ordinary interactions with information become transparent, eliminating the needless deformations introduced by our forty-year fixation on "the computer." You close the door to your office because you want privacy, and your phone and IM channel are automatically set to "unavailable." You point to an unfamiliar word in a text, and a definition appears. You sit down to lunch with three friends, and the restaurant plays only music that you've all rated highly. In each scenario, powerful informatics intervene to produce the experience, but you'd have to look pretty hard to turn up their traces. Such interactions are supposed to feel natural, human, right.

Well and good, in principle. How does it work in practice? Let's take a canonical example: the exchange of business cards.

This tiny ritual - and let there be no doubt, on the part of unwary designers prepared to unilaterally "reimagine" it, that ritual is precisely what this is - happens by the million every day, throughout the commercial world. The practice differs from place to place, but it is always important, always symbolically freighted with performances of status and power, or alternately accessibility and openness. It's no stretch to assert that billion-dollar deals have hinged on this exchange of tokens. How could it be reimagined as everyware?

One, relatively crude and timid, expression might propose that, instead of the inert slips of paper we now proffer, we hand out RFID-equipped "smart" cards encoding our contact information and preferences. (Maybe you'd tap such a card against a reader to place a call, without having to be bothered with the details of remembering a number, or even a full name; fans of *Aliens* may recall that Lt. Ripley availed herself of just such an interface, in her wee-hours call to corporate weasel Burke.)

In a more aggressive version of this story - the one related, for example, on NTT's Web site for its RedTacton prototype - the physical token disappears from the transaction; instead, a data file containing the same information is transmitted from one party to the other over a low-voltage network, using the skin's own inherent conductivity. Maybe, in a further refinement, the only data actually sent over the network is a pointer, a key to unlock a record maintained locally elsewhere.

And there it is, everyware's true and perfect sigil. Information has passed between two parties, information which has the effect of adding a node to one's personal or professional network. This is a transaction that takes several steps to accomplish on a contemporary social-networking site, and here it's been achieved with a simple handshake - an act externally indistinguishable from its non-enhanced equivalent. Here we can truly begin to understand what Weiser may have been thinking when he talked about "disappearance."

If that's too abstract for you, let's take a look at MasterCard's RFID-equipped PayPass contactless payment system, which will have been introduced commercially (branded by Chase, in the New York City area, as "Blink") by the time this book is published. MasterCard's tagline for PayPass is "tap & go," but that belies the elaborate digital choreography concealed behind the simple, appealing premise.

Schematically, it looks like this: You bring your card, keyfob, or other PayPass-equipped object into range, by tapping it on the reader's "landing zone." The reader feeds power to the device's embedded antenna, inductively, which powers the chip. The chip responds by transmitting an encrypted stream of data corresponding to your account number, a stream produced by modulating the strength of the electromagnetic field between it and the reader.

From this point forward, the transaction proceeds in the conventional manner: the reader queries the network for authorization, compares the amount of the purchase in question with the availability of funds on hand, and confirms or denies the purchase. And all of that happens in the space of 0.2 seconds: far less than a single heartbeat, and, as MasterCard clearly counts on, not nearly enough time to consider the ramifications of what we've just done.

Intel Research's Elizabeth Goodman argues that, "[t]he promise of computing technology dissolving into behavior, invisibly permeating the natural world around us cannot be reached," because "technology is...that which by definition is separate from the natural." In the face of technologies like PayPass, though, I wonder if she's right. I don't think it's at all unlikely that such transactions will effectively become invisible - at least, for most of us, most of the time.

I do, however, think it's of concern. If this dissolving into behavior is the Holy Grail of a calm and unobtrusive computing, it's also the crux of so many of the other issues which ought to unsettle us - simultaneously everyware's biggest promise, and its greatest challenge.

Thesis 19 *Everyware is always situated in a particular context*

Nothing takes place in a vacuum. As former PARC researcher Paul Dourish observes, in his 2001 study *Where the Action Is*, "interaction is intimately connected with the settings in which it occurs." His theory of "embodied interaction" insists that interactions derive their meaning by occurring in real time and real space, and above all among and between real people.

In Dourish's view, the character and quality of interactions between people and the technical systems they use depend vitally on the fact that both are embedded in the world in specific ways. A video chat is shaped by the fact that I'm sitting in this office, in other words, with its particular arrangement of chair, camera and monitor, and not that one; the appropriateness of mapping a given gesture to a system command will seem different to Sicilians or Laotians or Senegalese.

This seems pretty commonsensical, but it's something that by and large we've been able to overlook throughout the PC era, without incurring any particular penalty. This is because personal computing is something that we've historically conceived of as being largely independent of context.

In turning on your machine, you enter the nonspace of its interface - and that nonspace is identical whether your laptop is sitting atop your desk at work, neatly aligned with its edge, or teetering atop your knees on the library steps. Accessing the Web through such interfaces only means that the rabbit hole goes deeper; as William Gibson foresaw (whether by happenstance or intention) in the first few pages of *Neuromancer*, it really is as if each of our boxes is a portal onto a "consensual hallucination" that's always there waiting for us. No wonder technophiles of the early 1990s were so enthusiastic about virtual reality: it seemed like the next logical step in immersion.

But everyware is something akin to virtual reality turned inside out. So it matters quite a lot when we propose to embed functionality in all the surfaces the world affords us: we find ourselves deposited back in actuality with an almost-audible thump, and things work differently here. If you want to design a system that will let drive-through customers "tap and go" from the comfort of their

cars, you had better ensure that the reader is within easy reach of a seated driver; if your building's smart elevator system is supposed to speed visitor throughput, it probably helps to ensure that the panel where people enter their floors isn't situated in a way that produces bottlenecks in the lobby, and so on.

There are other ways in which interactions are conditioned by the apparently trivial fact that they take place in real space. Think of all of the subtle, nonverbal cues we rely upon in the course of a multi-party conversation, and how awkward it can be when those cues are stripped away, as they are in a conference call.

Some ubiquitous systems have made attempts at restoring these cues to mediated interactions - one of Hiroshi Ishii's earlier projects, for example, called ClearBoard. ClearBoard attempted to "integrate interpersonal space and shared workspace seamlessly"; it was essentially a shared digital whiteboard, with the important wrinkle that the image of a remote collaborator was projected onto it, "behind" what was being drawn on the board itself.

Not only did this allow partners working at an arbitrarily remote distance from one another to share a real-time workspace, it preserved crucial indicators like "gestures, head movements, eye contact and gaze direction" - all precisely the sort of little luxuries that do so much to facilitate communication in immediate realspace, and which are so often lacking in the virtual.

A sensitively-designed everyware will take careful note of the qualities our interactions derive from being situated in real space and time. The more we learn, the more we recognize that such cues are more than mere niceties - that they are, in fact, critical to the way we make sense of our dealings with one another.

Thesis 45 *Users will understand their transactions with everyware to be essentially social in nature, whether consciously or otherwise*

There's good reason to believe that users will understand their transactions with ubiquitous systems to be essentially social in nature, whether consciously or otherwise - and this will be true even if there is only one human party to a given interaction.

Norbert Weiner, the "father of cybernetics," had already intuited something of this in his 1954 *The Human Use of Human Beings*: according to Weiner,when confronted with cybernetic machines, human beings found themselves behaving as if the systems possessed agency.

This early insight was confirmed and extended in the pioneering work of Byron Reeves and Clifford Nass, published in 1996 as *The Media Equation*. In an extensive series of studies, Reeves and Nass found that people treat computers more like other people than anything else - that, in their words, computers "are *close enough to human* that they encourage social responses." (The emphasis is present in the original.) We'll flatter a computer, or try wheedling it into doing something we want, or insult it when it doesn't - even if, intellectually, we're perfectly aware how absurd this all is.

We also seem to have an easier time dealing with computers when they, in turn, treat us politely - when they apologize for interrupting our workflow, or otherwise acknowledge the back-and-forth nature of communication in ways similar to those our human interlocutors might use. Reeves and Nass urge the designers of technical systems, therefore, to attend closely to the lessons we all learned in kindergarten, and engineer their creations to observe at least the rudiments of interpersonal etiquette.

Past attempts to incorporate these findings into the design of technical systems, while invariably well-intentioned, have been disappointing. From Clippy, Microsoft's widely-loathed "Office Assistant" ("It looks like you're writing a letter"), to the screens of Japan Railways' ticket machines, upon which animated hostesses bow to the purchaser at the completion of each transaction, none of the various social interfaces have succeeded in doing

anything more but reminding users of just how stilted and artificial the interaction is. Even Citibank's ATMs merely sound disconcerting, like some miserly cousin of HAL9000, when they use the first person in apologizing for downtime or other violations of user expectations ("I'm sorry - I can only dispense cash in multiples of $20 right now").

But genuinely internalizing the *Media Equation* insights will be critical for the designers of ubiquitous systems. Some are directly relevant to the attempted evocation of seamlessness ("Rule: Users will respond to the same voice on different computers as if it were the same social actor"), while others speak to the role of affect in the ubiquitous experience - notably, their finding that the timing of interactions plays a critical role in shaping their interpretation, just as much as their content.* All will help designers accept the notion that people will more often understand their interactions with everyware to be interpersonal in nature than technical.

These findings take on new importance when people encounter a technology that, by design, borders on the imperceptible. When there are fewer visible cues as to a system's exact nature, we're even more likely to mistake it for something capable of reciprocating our feelings - and we will be that much more hurt if it does not.

*The specific example Reeves and Nass offer is how we react when praise is delayed by a critical few beats in response to a query - i.e. not well.