Interaction Anxieties- Omar Khan
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In a recent article1, interaction design consultant Donald Norman sounded some warnings about the new trend in interaction design - the *natural user interface* (NUI). NUIs look to replace the graphical user interface (GUI) with more "natural" interactions including speech, touch and gestures. Steve Ballmer, CEO of Microsoft, is quoted saying that 2010 will be remembered as the year when the shift to NUIs took place. Norman is not convinced. He takes exception to the "natural" designation of NUIs and warns against the limits of gestures for interaction design. His reservations include that gestures are not natural, but like graphical interfaces have to be learned. They are ephemeral and don't leave a trace of their path, thus providing little feedback to users, and they can easily be misinterpreted by people and more consequently computers. Norman's critique however, is tempered by his recognition that NUIs "will enhance our control, our feeling of control and empowerment, our convenience and even our delight."2 But that will only come once NUI's develop "well-defined modes of expression, a clear conceptual model of the way they interact with the system, their consequences, and means of navigating unintended consequences."3

Norman's objections must be placed in the context of interaction design's historical focus on the workplace machine4. Here research has pursued the design of effective interfaces, hardware and software through which information in a computer's memory can be easily accessed and manipulated. Its products, the mouse, keyboard, stylus and GUI, have transformed computers from specialized machines to universal work appliances. Norman's skepticism reflects the limits of NUIs for the types of interactions that we have become accustomed to with our GUIs. It also reflects a deeper anxiety with the changing nature of computing that is increasingly mobile, materially embedded and pervasive. Perhaps the interactive capabilities of the workplace machine are not a suitable model for this type of computing? Or that effective interfacing will not be the measure of effective or affective interaction in the age of pervasive computing? Could it be that interactions will not only be for information exchange but designing, provoking and situating a variety of social and cultural practices? With buildings, clothes, objects and places becoming computationally augmented we need to take a more holistic view of interactivity and explore how it can assist in constructing productive and provocative relations between people, places and computing instruments. What role does space, mobility and embodiment play in such constructions? How will interaction affect our understanding of our own agency in perceiving and acting in space? And what of the agency of sentient systems through and with whom we will interact?

The expansion of our understanding of what interactivity could be as computation becomes pervasive requires a shift away from the instruments of interactions - screens, mice, speech, gestures, tangible interfaces - and towards the relations we expect to achieve from them. These include the ways in which we communicate and socialize with one another and inhabit our cities and world. We need to speculate on the cultural and aesthetic worth of interactivity in order to accommodate it more properly in our lifestyles. At the same time, we also need to recognize the opportunities that computing in its different forms - mobile, embedded, and pervasive - offers for changing our expectations and usage of space, architecture and urbanism.

Interactivity's unique aesthetic potential for our media, architecture and cities requires the participation of designers, artists, architects and urbanists to help situate these technologies. With pervasive computing's technological inevitability it is imperative that designers, architects and artists contribute to the imaginary of these sentient systems.

Interactivity's Destabilizing Aesthetics

In the early theorizing of interactive art, the integral role of the viewer as an active participant in the construction of the aesthetic experience was noted5. Burnham observed that interactivity's two-way communication between observer and artwork resulted in a "figure-ground reversal in human perception of the environment"6. This resulted in an aesthetic shift from a fixed viewer-object relationship to one in which the observer was understood as an integral part of his or her environment. Further, through interaction the separation of the viewer and the work of art was negated, "fusing both observer and observed, 'inside' and 'outside'."7 Hence interactivity as it empowers the observer to engage and influence the work of art, destabilizes this control by allowing her to lose herself through the work. In other words, interaction puts the observer at risk, such that her participation can result in desired outcomes or unpredictable surprises or even utter failures. This is an important aspect of interactivity's aesthetic effect.

This is different from Umberto Eco's observation of the aesthetics of the "open work."8 Eco's polemical study of modernist works in which the performer or reader is tasked with "finishing" the work through his/her "reading" suggests a similar aesthetic engagement. However, the open work engages the reader in a more structured way. Eco explains, "The author offers the interpreter, the performer, the addressee, a work to be completed. He does not know the exact fashion in which his work will be concluded, but he is aware that once completed the work in question will be his own. It will not be a different work, and, at the end of the interpretive dialogue, a form which is his form will have been organized, even though it may have been assembled by an outside party in a particular way that he could not have foreseen."9 Hence the reader remains "outside" the artwork. Where the open work requires interpretation from the observer, interactivity requires intervention.10

Espen Aarseth in his study of cybertexts calls this a "cyborg aesthetic."11 Taking his cue from Donna Harroway's "A Cyborg Manifesto" (1991) who used the cyborg, "a hybrid of machine and organism," as a concept to challenge fixed categories of gender, nature, race and identity, Aarseth speculates on the cyborg as a means to problematize power and control structures. He writes, "Any cyborg field, as any communicative field, is dominated by the issue of domination and control. The key question in cyborg aesthetics is therefore, who or what controls the text? Ideologically there are three positions in this struggle: author control, text control and reader control."12 And then following a discussion of John Cayley's computer program, Book Unbound (1995) that algorithmically produces text through user interaction: "the text is an impurity, a site of struggle between medium, sign and operator. The fragments produced are clearly not authored by anyone. They are pulverized and reconnected echoes of meaning, and the meaning that can be made from them is not the meaning that once existed… The pleasure of this text is far from accidental; it belongs not to the illusion of control but to the suggestive reality of unique and unrepeatable signification."13

To further explicate this aesthetic effect, David Rokeby's Very Nervous System (1986-1990) is a powerful demonstration of the cyborg aesthetic. Rokeby designed a machine vision system that could interpret physical gestures and translate them into sounds. Moving your arms and legs at different speeds and heights produced commensurate sounds that you could come to control or give yourself up to. As Rokeby explains, "The feedback is not simply 'negative' or 'positive', inhibitory or reinforcing; the loop is subject to constant transformation as the elements, human and computer, change in response to each other. The two interpenetrate, until the notion of control is lost and the relationship becomes encounter and involvement. The diffuse, parallel nature of the interaction and the intensity of the interactive feedback loop can produce a state that is almost shamanistic. The self expands (and loses itself) to fill the installation environment, and by implication the world."14

The simultaneously enabling, yet destabilizing, nature of interactivity undermines who or what is in control. Instead, interactivity puts control into play, something to be negotiated in the performance of the act. A genuine dialogue or conversation with the computer remains the ideal15, but in lieu of it we are witnessing that even lopsided two way communications, like those we have with our pets, yield provocative, but extremely fulfilling exchanges. While there is a palpable anxiety that results from the unanticipated barking of such exchanges, we can look forward to more intimate and unpredictable relationships with our architecture and places of habitation.

Cybernetic Organizations

One of the important theoretical shifts in Human Computer Interaction (HCI) has been the move away from a naive cognitivist view of information as a pure construct of mental processes towards a more phenomenological framing of information as situated16, contextual17and embodied18. Paul Dourish's work on embodied interactions recognizes "that action and meaning arise in specific settings - physical, social, organizational, cultural, and so forth," 19and that "meaning is conveyed not simply through digital encodings, but through the way that computation enlivens those encodings with semantic and effective power."20 For interactivity this suggests that our lived context is also in play in human-computer communications. This should be encouraging for architects, designers and artists, for whom the "context" of everyday life is a familiar part of their work.

One caution that I have with this approach is that it runs the risks of reifying the everyday. With its focus on developing interactive technologies that support situated actions, it inadvertently fixes located practices and undermines any technology that might accidentally or intentionally disrupt them. As Malcolm McCullough explains, "contexts remind people and their devices how to behave. That framing has often been done best and understood most easily as architecture. Something about the habitual nature of an environmental usage gives it life. Like device protocols and personal conduct, architecture has the form of etiquette. Like most etiquette, architecture exists not out of pompousness, but because it lets life proceed more easily. Situated computing extends this age-old preference, where as anytime-anyplace computing does not."21 It is unclear to me whether truly interactive systems can subscribe to any preordained etiquettes. A cyborg aesthetic precludes such notions of "good" and "bad"

behavior since meanings emerge out of the interaction. As such, it puts us in a participatory relationship with our environment, fortifying our agency while not necessarily reciprocating it with control.

Perhaps another way to address the issue of "setting" is to also put it in play with the interacting subject and computing technologies. This would suggest a more complex ensemble of interacting parts that includes people, places and things in a feedback loop with one another. It would require that we take the cybernetic aspect of the cyborg aesthetic more seriously. The question to ask is, what kinds of relationships would emerge out of such feedback systems? In "What is Interaction? Are there different types?",22 Dubberly, Pangaro and Haque take a pass at this by developing an expanded taxonomy of interaction. They describe interactive systems as a set of relations - linear, self-regulating and learning - that can be combined with one another to create more complex interactions. Theirs is a systems design approach, where the behaviors, rather than the particular mechanism that produce them, are explored.

Linear systems are those that take inputs and produce some predictable output. They demonstrate a cause and effect relationship which makes them more reactive than truly interactive. We witness this with our computers when we query them to perform some information processing or when an automatic door opens in response to our proximity. Self-regulating systems are systems with goals that establish cyclic or feedback relationships with different constituents. For example, a thermostat in a room set to 70 degrees performs the function of turning a boiler on or off depending on the room's temperature, which in turn activates the thermostat. The function and response of each component, thermostat, boiler, and room temperature, mutually regulate the comfort of the room. In cybernetic terms, control is distributed since all the parts affect one another. Finally, there are learning systems that are able to evaluate their goals and change them in order to follow new ones. This is the realm of sentient systems that can learn from their context and change their actions accordingly. Humans are of course extremely complex learning systems capable of adapting their intentions at will. But this is in response to specific contexts, situations and environments. Hence, as a learning system they are not autonomous, but part of an ensemble of interacting parts that include other people, technologies and environments.

Let me explain this through an example. During the hot summers of New York City it is common to see an open fire hydrant used by local residents to cool themselves and the street. This is illegal, as it compromises the hydrant's function for firefighting. To address this, the city has put water saving spray caps on the hydrants that allow them be used for recreational purposes, but with limits. Supervision of the technology remains in the hands of the fire department which more often than not results in residents clandestinely removing the caps. The problem of the hydrant is that it is tasked with two very different programs; one, fire safety, and the other, recreation (although public health could also be included in this). The cap solution is purely technological and hence linear. The fire department is responsible for legislating both safety and recreation. If one was to frame the solution as self-regulating, then the users of the technology would have to be included in regulating and maintaining the technology. This would require a different governance structure involving block clubs, resident education and a more user friendly cap. Finally, if we were to imagine it as a learning system, it would include an information layer that could anticipate changing needs based on weather, water pressure,

local fires, past use, etcetera, and condition future use of the technology accordingly. More significantly, such a development would make residents, the fire department and other governing bodies more aware of one another and their role in maintaining the health of their environment.

What is helpful about a systems approach to interactions is that we are in the realm of modeling - where we can speculate on the behaviors of interactions without getting bogged down by their specific mechanisms. This is a fundamental part of designing, where options can be imagined and studied before they are subjected to the necessary rigors of problem solving for a specific context. Also, such a structure maintains the indeterminacy of interactivity, with the different actors in play exercising different controls on one another. The formulation of these three particular types, linear, self-regulating and learning is not incidental, but comes out of the history of cybernetics23 where inquiry into "control and communication in the animal and machine,"24 recognized that particular behaviors like self-regulation and learning could emerge out of the cyclic communication witnessed in interactivity. As such, they reflect a historical effort in coming to terms with responsive behavior across biological, social and technological systems.25

Shifting Agencies

As our devices, buildings and cities become interactive, we will need to address the possibility that they may require little or no involvement from us to carry out their functions. The evolving Internet of Things envisions connecting a host of heterogeneous digital devices through Web 2.0 protocols to create self directed communications between such objects. "From anytime, any place connectivity for anyone, we will now have connectivity for anything."26 Digitally enabled things will autonomously produce (sense and process) information locally and share it globally with other devices. One can imagine a self-regulating city where buildings monitor their own energy resources, negotiate their needs with a smart energy grid, and communicate with other buildings to better collectively manage their shared resources. Human participation in the exchange would be minimal since the interacting systems would be well programmed in bartering with one another. What does this say about interactivity? For one thing, it would suggest that human participation need not be central to it. Interacting buildings at a minimum could qualify as self-regulating and at their most ambitious capable of learning. But can interaction take place without human involvement or, at the least, is human observation a necessary part of it? How are we to understand our own agency in this coming Internet of Things?

There are two ways to think about the sentient machines of the Internet of Things. The first is as automation, where machines are tasked with performing work in our place. The imaginary of the robot is perhaps the most appropriate example, which as a human proxy performs the rote tasks that we find too tedious or complicated to do ourselves. But does automation preclude a role for humans in the process? Lev Manovich argues that in automation human involvement moves from active to passive. He writes, "It is important to note that automation does not lead to the replacement of human by machine. Rather, the worker's role becomes one of monitoring and regulation: watching displays, analyzing incoming information, making decisions and operating controls."27 Interactivity here is qualified with a requirement to wait for something to

happen before there is a need to act. As such delegating one's active agency to perform some task to a sentient machine does not preclude human participation, even if it is only as passive observation; it only becomes deferred.

Another way to think about our shifting agency with regard to the Internet of Things is through "interpassivity", which is the "uncanny double" of interactivity. As Slavoj Zizek explains, "The obverse of interacting with the object (instead of just passively following the show) is the situation in which the object itself takes from me, deprives me of, my own passivity, so that it is the object itself which enjoys the show instead of me, relieving me of the duty to enjoy myself."28 Zizek gives the example of the Tibetan prayer wheel that mechanically turns to perform prayers. The worshipper can activate it or more practically let the wind turn it to do the praying for him. Other examples include the chorus in a Greek tragedy that feels for you, the canned laughter on a TV-comedy sitcom that laughs for you, and the movie recording VCR that watches the movie for you. Unlike the interactive or the automated where the human subject is active (in different degrees) through the other objects, in the interpassive the subject forgoes participation, even the passivity of observing, and draws pleasure from delegating that passivity to the objects.

This is the guilty pleasure that we hope for from "smart grids", "self-regulating buildings" and "smart materials". They forecast solutions for the pressing problems of climate change and sustainable energy without requiring any substantial activity form us. We won't need to examine our own consumption nor change the way we do things, since our sentient buildings will manage the problem. As one of the provocative images of ubiquitous computing, "they weave themselves into the fabric of everyday life until they are indistinguishable from it."29 But the pleasure will still be ours.

Conclusion

If gestures and speech are the next big thing in the silicon alleys and valleys of the world then that is a good development. At least we will be using our bodies and engaging one another and our technologies in less prescribed ways. That this may result in miscommunications is inevitable, but my anxiety is not the same as Norman's. Where he is looking to institute clear protocols for such systems, I am concerned with how the aesthetic potential of interacting ensembles will be compromised by unwarranted caution like his.

For the design of sentient cities that include responsive buildings, infrastructure, transportation and mobile devises, the concern for the moment should be on the kinds of interactions we want. This is a cultural question that requires us to probe the efficacy of interactive technologies and what it means for the ways in which we want to live. The role of designers, architects and artists in forecasting this is paramount, but caution needs to be taken in projecting uncritical utopias. The technologies are there - it is the imaginary of contemplating the interacting ensembles that is missing.

Whether NUIs, TUIs30, GUIs or any other form of interfacing will be more adequate than the other will depend on the situation. Inevitably all will be in play, but to model the communication that we expect from such interactions on the workplace machine is misdirected.

It will only force us into tempering interactivity and not recognizing its potential for displacing control and allowing unanticipated encounters to emerge. This potential is what designers, architects and artists aspire to in their work. It provides opportunities to delegate our agency to sentient systems, our activity as well as our passivity. Both yielding pleasurable and inventive results.

Interactivity is cyclic and risky
It allows complex and meaningful ensembles of people places and things to form
It is affected by context but also affects the context displacing control
It can yield behaviors like self regulating and leaning

Notes

1. Donald Norman, "Natural User Interfaces are not natural," *Interactions*, v.XVII.3 (2010): 6-10.
2. Ibid., 6.
3. Ibid., 9-10.
4. See Bill Moggeridge, *Designing Interactions*, (Cambridge, MA: MIT Press, 2007) which is a personal chronicling the development of computer interfaces.
5. Jack W. Burnham, "The Aesthetics of Intelligent Systems," in *On the Future of Art*, ed. Edward F. Fry (New York: The Viking Press, 1970), 95-122.
6. Ibid., 100.
7. Ibid., 103.
8. Umberto Eco, *The Open Work*, trans. Anna Cancogni (Cambridge, MA: Harvard University Press, 1989).
9. Ibid., 19.
10. Espen J. Aarseth, *Cybertext- Perspectives on Ergodic Literature* (Baltimore: Johns Hopkins University Press, 1997).
11. Ibid., 54-56.
12. Ibid., 55.
13. Ibid. 56.
14. See David Rokeby's website for Very Nervous System: David Rokeby, "Very Nervous System," http://homepage.mac.com/davidrokeby/vns.html.
15. A computer's ability to carry on a dialogue with its user remains the measure of artificial intelligence. Alan Turing's famous Turing test, as proposed in his paper "Computing Machinery and Intelligence", *Mind* LIX 236 (1950): 433–460, made the conversational exchange an indicator of intelligence. John Searle's "Minds, Brains and Programs", *Behavioral and Brain Sciences* 3 (3) (1980): 417–457, counters that an intelligent conversation could be simulated by a machine indicating neither understanding nor a consciousness. See also cybernetican Gordon Pask's conversation theory that lays out axioms for conversational interactivity with machines: Gordon Pask, *Conversation Cognition and Learning* (Amsterdam: Elsevier, 1975).
16. Lucy Suchman, *Plans and Situated Actions: The Problem of Human-Machine* Communication (Cambridge, UK: Cambridge University Press, 1987).
17. Malcolm McCullough, *Digital Ground- Architecture, Pervasive Computing and Environmental Knowing* (Cambridge: MIT Press, 2004).

18. Paul Dourish, *Where the Action Is- The Foundations of Embodied Interaction* (Cambridge, MA: MIT Press, 2004).
19. Ibid., 161.
20. Ibid., 163.
21. Malcolm McCullough, *Digital Ground- Architecture, Pervasive Computing and Environmental Knowing* (Cambridge: MIT Press, 2004), 118.
22. Hugh Dubberly and Paul Pangaro and Usman Haque, "What is Interaction? Are there different types?" *Interactions* v.XVI.1 (2009): 69-7.
23. For a succinct general review of the history of cybernetics (first and second order) see Bernard Scott, "Second-order cybernetics: an historical introduction," *Kybernetes*, Vol. 33 No. 9/10 (2004): 1365-1378. For a more in-depth reading of the history of cybernetics see Steve J. Heims, *The Cybernetics Group* (Cambridge MA: MIT Press, 1991) and the transactions of the Josiah Macy Conferences on Cybernetics 1950-54: Heinz von Foerster, ed., *Cybernetics, circular causal and feedback mechanisms in biological and social systems: transactions* (New York: Josiah Macy, Jr. Foundation, 1952) .
24. Norbert Weiner's subtitle to his polemical book on cybernetics: Norbert Weiner, *Cybernetics: Or Control and Communication in the Animal and the Machine* (Cambridge, MA: MIT Press, 1948).
25. See the transactions of the Josiah Macy Conferences on Cybernetics 1950-54: Heinz von Foerster, ed., *Cybernetics, circular causal and feedback mechanisms in biological and social systems: transactions* (New York: Josiah Macy, Jr. Foundation, 1952).
26. International Telecommuncations Union, *The Internet of Things*- Executive Summary, (Geneva: International Telecommunication Union (ITU), 2005): 2.
27. Quoted in Erkki Huhtamo, "From Cybernation to Interaction: A Contribution to the Archaeology of Interactivity," in *The Digital Dialectic*, ed. Peter Lunenfeld (Cambridge, MA: MIT Press, 2000), 96-110.
28. Slavoj Zizek, *How to Read Lacan* (New York: W. W. Norton & Company, 2007).
29. From the opening statement of Mark Weiser's polemical article on ubiquitous computing, "The Computer for the 21st Century," *Scientific American* Volume 265, No. 3 (1991): 94-100. The entire statement reads, "The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it."
30. Abbreviation for Tangible User Interfaces. For more information see Hiroshi Ishii and Tangible Media Group, *Tangible Bits: Towards Seamless Interface between People, Bits, and Atoms (*Tokyo: NTT Publishing Co., Ltd., 2000).