The Case for Building Familiarity into Wearables Design

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Abstract

This paper examines the issues connected with the development of wearable devices in terms of affective design, that is, as pleasurable products. Wearables, particularly in the context of everyday use, have the ability to become good examples of what Steve Mann termed 'existential computers'. This phenomenological state will only come about, however, if the product/user fit is good for all aspects of the design. Here we examine the design aspect of familiarity and how choice of materials can affect the approachability of the wearable, and the subsequent relationship between it and the wearer. Finally a combined design through making and participative methodology is suggested for taking the work further.

1. Introduction

Of the new, Pablo Picasso said of his work:

> When you make a thing, a thing that is new, it is so complicated making it that it is bound to be ugly. But those that make it after you, they don't have to worry about making it. And they can make it pretty, and so everyone can like it when the others make it after you. [1]

The field of wearables has to date focused largely on such formal aspects of design as appropriateness of functionality [2, 3], placement of interfaces [4], wearability [5, 6], or power sources [7]. More recently interest has also been shown in more experiential aspects such as covertness of use [8], and societal impact [9], and Infineon Technologies and Philips, in the New Nomads project, have made large efforts to link wearables with consumer lifestyles through fashion [10]. Indeed most fashion design institutes now offer wearable technology modules (see for example, the Parsons School of Design, New York or the Royal College of Art in London). While these efforts to understand the user holistically rather than as a collection of problems to be solved is commendable, they are not at present backed up by academic research within the field. This paper seeks to begin to address this need through an examination of phenomenology, affective product design, and crafts processes within a framework of the issues surrounding the design of wearable computing devices. Further support for the timeliness of the research is given in an overview of historical precedents, and we conclude that the design aspect of familiarity, common to the three perspectives discussed, offers a promising approach to the development of novel personal products, in particular that of wearable devices. We finish with suggestions for methods of incorporating the findings into a design process.

2. Issues with Wearables for Everyday Use

Since the inception of the international Symposium in 1997, wearables have provided a broad arena for serious research within various disciplines. If the discipline of design can be described as the identification and subsequent solving of a set of problems, then wearables offers a unique range of seemingly unending design challenges. Alexander saw design as the setting of solutions to problems as either successful (given a value of 1) or not (given a value of 0), and of mutually exclusive components within a project canceling each other out [11]. Given the criteria frequently cited in the definition of wearable computers, given in the table below, this approach would perhaps seem to be at best challenging, and at worst unworkable.

The wearable:
does not constitute the main task, cognitive load
should not restrict the user
is usable without secondary action (switching on, picking up, etc.)
is controllable by the user
is glanceable or offers peripheral display
has close proximity to the body
is used for extended periods of use
should offer social flexibility
be contextually aware of the environment and

Figure 1. Defining wearables

The extent of work required by the proof of concept stage has meant that to date, technological feasibility has formed the basis of much research being done in attempting to meet these criteria, for example in the fields of sensing, wireless networks, power sources, image processing and mediated reality. However, Steve Mann, one of the first and most important exponents of the paradigm, gave other aspects of wearable design equal emphasis. He understood the wearable to be *eudaemonic*, in that it becomes "subsumed into the personal space of the user", *existential*, in that it behaves "as an extension of the body", and *constant*, in that it that it "may sleep, but never die" [12]. As such, the wearable offers at least as much scope for study in the fields of sociology, psychology and philosophy as it does in computing, and the cross-disciplinary design issues identified in a trialogue in interactions magazine hold particularly true for this paradigm [13]. Now we are reaching the stage where it is recognized that the aim of the wearable is not to replicate the functionality of the desktop PC, but rather to support the user in context, it is becoming more important to extend the development problem space to consider other 'soft' aspects of functionality in the struggle to meet Mann's criteria. Three such aspects are explored below.

3. A Philosophical Perspective

The space we expect the user to allow the wearable into is both physically and psychologically extremely personal. The wearable by definition is in close physical proximity to the human body, and typically worn or used for extended periods of time, and as a result acquires great potency of meaning for the user. Even before it is first put on, the user is aware of the intimate nature of the device, and this is a non-trivial obstacle for the wearable designer to overcome in the if the paradigm is to become accepted by a broader public. An understanding of certain philosophical approaches may be useful in closing the space between the object (wearable) and user. For example, the immediacy of sensory perception as described by Merleau-Ponty or Heidegger should not be discounted; rather, they are useful in that they point to a more involved use of material and aesthetic in design towards the creation of meaningful objects. Heidegger, in fact, dealt with the concept of familiarity in his key work Being and Time. While it may at first appear to be a concept so readily available through commonsense as to be unworthy of study, Heidegger held that its very triviality revealed fundamental aspects of human nature. He saw familiarity as being based on the non-cognitive involvement of the human being with its world, resulting in a unity of the two. Turner points out that Heidegger's analysis of familiarity is interesting because it underpins the work of key HCI literature from, for example, Winograd & Flores (1986), and Suchmann (1987) [14]. There is also an interesting link with the concept of tacit or embedded knowledge, which is to be found in much of the literature concerning craft practice. Michael Polanyi, for example, argued that acquired skills are accompanied by an inarticulable understanding [15], and Merleau-Ponty's Phenomenology of Perception "confirmed the inportance of lived experience in grasping the nature of language, perception and the body". Like Heidegger, Merleau-Ponty's work was grounded in, and had moved on from, the phenomenology of Husserl [16].

What we can usefully take from this as developers of personal, is an understanding that familiarity as a concept can underpin both design practice and the study of users' experiences with our products. The familiarity of a maker with his or her practice and materials results in objects with the ability to embody the human investment made in them, while the aspect of unity, of being-in-the-world, offers a philosophical grounding for the concrete investigative techniques HCI applies. More profound yet is the possibility of a connection between the familiarity of the maker and that experienced by the user. Paul Greenhalgh talks about the object as a shared place, a carrier of meaning where understandings may meet [17]. Thus the understanding of the maker is extended to the user, who may experience it as familiarity. An acceptance of this approach has ramifications for the development process of any product, but is especially compelling for the wearable given their intimate nature.

4. Beyond Usability

4.1. Satisfaction

Usability has served the HCI community arguably well for the last couple of decades, and as the common wisdom has it, any user evaluation is better than none. However, the human being is a "wanting animal". As soon as one perceived need is fulfilled, we see another ahead. Maslow's hierarchy of needs, described by the psychologist in 1970, can form a model for a hierarchy of consumer needs [18]. Thus where we were once content with the functionality of the mobile phone, we soon perceived the need for it to be easy to use. Now at a point where the mobile is easy to use, we want it to be more than just usable. It should be a pleasurable experience; it should delight us. As Dillon points out "The third component of the ISO-92411 definition of usability is satisfaction" [18], and while performance and affect are interrelated, satisfaction slips away from us. Figure 2 shows Jordan's hierarchy of consumer needs [18].

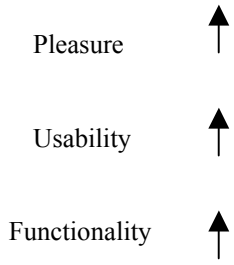

Figure 2. Jordan's Hierarchy of Consumer Needs

But what comes after pleasure? Figure 3 shows this hierarchy redrawn as a cyclical process, and the next section explores the basis for this new model.

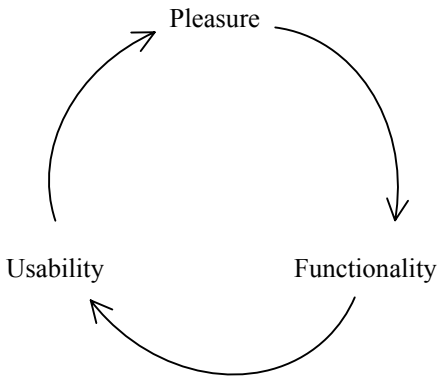

Figure 3. A Cyclical Hierarchy of Consumer Needs

4.2. An Historical Precedent

Usability can be said to have polarized art and science (*Figure 4*). Take, for example, the debate over web design. But of course, representation has long been recognized as more than the content of the message alone; McLuhan's legacy of the 'medium as message' holds as true on the web as anywhere. As human beings we accrue the tools for deciphering the world around us through all the sensory and cognitive channels available to us, and the language of visual art is carried through its elements of colour, tone, texture, and form. The personal computer has proved itself a powerful tool, but it is no longer enough for it to be a tool only. As it acquires new roles within every aspect of our lives, it becomes important to explore the messages carried by the computer's aesthetic elements. Indeed, Maggie Orth of MIT start-up International Fashion Machines, has called for a fully malleable computational material, a computing clay, to enable a full range of expression and the creation of meaningful computing artifacts [19].

meaningful products

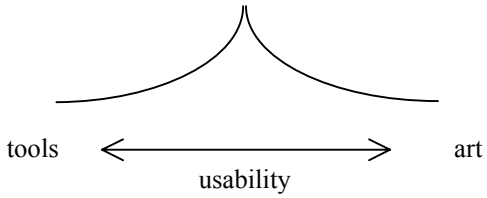

Figure 4. Art vs. Science

This polarization of art and science however, is not without precedent. It can also be seen in the aftermath of the Industrial Revolution. The power machinery brought to manufacturing processes prompted thinkers like Ruskin and Morris to question the motives of design. In his lectures given in Edinburgh in 1859, John Ruskin extrapolated the concept of functionality until the image painted was one of a Britain solely of brickfields, quarries and coal pits, turning the "useless inlets of the Cumberland, Welsh and Scotch lakes … into navigable reservoirs and canals ..." [20]. The late 19th century saw a backlash against technology in the form of a social movement of Utopian activity, as society, facing mass production for the first time, sought to render objects meaningful again. Handicraft became synonymous with a moral work ethic and the inherent goodness of the worker, and beauty became inextricably linked with natural form in an embracing of all that was rustic. Similarly, in the 1980's, the social theory of William Morris was revived in a backlash against the consumerist ethos of Reagan and Thatcher, manifesting itself as 'alternative' lifestyles and a preoccupation with Eastern philosophies and environmental issues [17]. It would appear that each time industrial society threatens to become either too consumerist, or is perceived to step too far beyond human parameters, that there will be a reaction of this kind to steady it. This is not to say that we should now take up the cause of Social Luddism in a bid to return to a mythological perfect past, or to ignore the opportunities that technological advances can offer, but rather to be aware that the human condition requires balance of the two, and that we are now ready for a reconsideration of the meaning, or lack of it, that surrounds us in the form of these technologies. Other fields currently reflect this. Within architecture for example there is a lively interest in meaningful places as opposed to 'non-places'; while places are encrusted with accrued meaning, non-places are unable to support any kind of organic social life [21], and current research in augmented reality has become interested in the concept of 'being there', seeking to understand the issues that affect our perception of place (see for example the Benogo project, [22]). This is the situation the developers of wearable computing devices face now. There is a healthy skepticism towards advances such as RFID tagging, nano-technology and ubiquitous computing, and we

cannot expect the wholesale take up of wearables, with their connotations of cyborgification and loss of privacy, without first considering consumer apprehensions and the human need for meaningful products.

4. Affective Approaches

Within product design and more recently within software applications design, there has been a shift of focus from pure usability to a more holistic approach including what has been described as 'soft' functionality [23]. Products do not exist in a functional vacuum. There are reasons for the proliferation of choice between one brand and another, or one price point and another, available to the consumer. Products do not merely perform or facilitate tasks, but also satisfy other human requirements such as cultural, social and emotional needs. This identification of qualitative aspects of design can help wearables become more approachable to the prospective consumer by making the technical content non-confrontational. It can change the current profile of the early adopter from that of knowledgeable technician to that of the layman or woman.

Hallnas and Redstrom emphasise the importance of presence as a concept for describing things, as opposed to functionality [24]. They identify this as the meaning that an object accrues within a user's lifeworld, through how it becomes a part of that world, and how it becomes accepted within it. For example, when we ask a friend about a particular table, they say, we will most probably hear how it came from her late grandfather, rather than about the load bearing properties of its design. In their treatment of the 'invisible' computer, they point to the phenomenological understanding of invisible, that is the thing can still exist; it becomes invisible once it is taken for granted. Just as presence grows with time, so does phenomenological invisibility. As a method of designing for this kind of presence, Hallnas and Redstrom suggest the use of properties of expressions to create expressionals as opposed to appliances, an approach more familiar in art and design than in HCI research. This is the conscious use of semantics to load an object with expressive qualities, and thus meaning, which can be read by others. The use of the terms appliance and expressional here echo Baudrillard's tool and object, and are parallel with his redefinition of the user as owner, where being an owner involves some emotional involvement [25]. It is also interesting to note, however, Baudrillard's simultaneous preoccupation with the freeing of the object from its function, thus freeing man from his role as user. Of course, there is no real escape. Aesthetics are bound to be read as having meaning, and as such are connected to affordance, which concern the perception of a thing's possible function. A purely existential object cannot be designed as it precludes both the profiling of a user group, and a meaningful aesthetic without connotations of function.

More pragmatic is the approach found in Pat Jordan's *Designing Pleasurable Products* [18]. A user target group based approach is described with a solid base in anthropology, and the Four Pleasure Framework identifies, as the name suggests, four pleasures: physio, socio, psycho and ideo. Physio-pleasure is sensory based, and includes anything concerning the body, socio-pleasure concerns our relations with others, whether that be family, colleagues or society as a whole. This type of pleasure also includes membership of social groups. Psycho-pleasure deals with cognitive and emotional reactions, while ideo-pleasure is value based, and includes 'theoretical' entities such as books, art and belief systems. C. S. Lewis in The Four Loves, meanwhile, describes need-pleasure as the absence of discomfort, or the move from a state of discontent to one of contentment. He also identifies pleasures of appreciation, which are positive contributions to the state of the individual, no matter how content they were to begin with. Jordan gives the example of a glass of water providing a need-pleasure, while a glass of wine, which, while it may alleviate thirst, is more likely to be consumed for the pleasant feeling of intoxication it gives. Using these categories to think about the total information gathered about individual subjects can help structure the design process through the development of products benefits specifications which correlate with the particular pleasures associated with that user. Because 'hard' functionality can also be evaluated through the categories physio and need-pleasure, Jordan is thus able to articulate useful steps towards a complete holistic design process. Particularly useful are the case studies linking experiential benefits, for example, the feeling of elegance when drinking, to formal design properties, such as the weight or height of a drinking glass.

5. A Crafts Perspective

As we have already seen even in this paper, craft became the political vehicle for the anti-industrial lobby of the late 19th century in England [17, 20]. A legacy of this is that it has come for many to represent an idyllic rural lifestyle embodying 'back to basics' utopian values, and the amateur craftsperson has to a great extent come to symbolize the whole field. Greenhalgh agrees that this is a laudable effort by individuals to "physically engage with things in an overly pre-packaged world", but that it is nevertheless fundamentally different from the activities of the professional, who conducts research in order to objectify the subjective impulses involved [17]. This is frequently achieved through the hands on exploration of material properties, an immediate activity which has an

impressive body of literature to support it with roots in phenomenology (see for example, [15, 16, 26, 27, 28]). If delight is an aim of affective design, then the intimate knowledge of the material resulting from such engagement is needed. McCulloch cites Jerome Bruner: "For the production of creative surprise demands a masterful control of the medium" [28]. This design led approach does not place the task first as does usability, but instead often results in objects without function. Typical of this is the contemporary pot which does not act as a functioning vessel (see *Figure 5*). This may seem an alien approach to the usability engineer, but has value in the exploration of form and material. While mass produced products may be said to be merely competent, or executed with indifference, craft objects are presented here as carriers of symbolic weight, profound memorabilia and creators of meaningful places, thanks to this engagement of the maker. Through their embodied memory and connection with others, they allow the owner then to situate them within his or her environment, creating a lifeworld and personal identity (see [24 and 25] for discussions of this). In hoping to overcome consumer apprehensions towards technology in such close physical and psychological proximity, the wearables developer could do much worse than to take on board this kind of craftsperson's sensibility for material and practice.

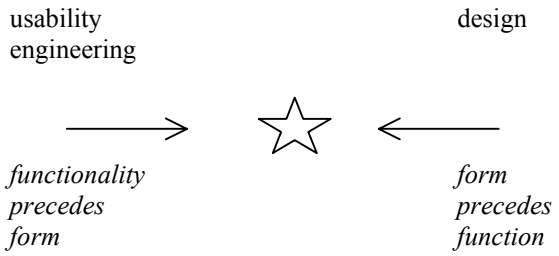

Figure 5
Design *vs.* Engineering

6. Familiarity

Design and technologists group IDEO in their work for ElekSen hit upon a very important concept in 'active memory'. They described this as the conferring of familiarity on new objects by "current memories we have as human beings into products that have not existed before", and applied the approach to the design of a range of novel communication products using state of the art sensing fabrics [29]. The concept of active memory, or familiarity, in HCI and even product design is quite new, however, and requires a brief exploration here for the sake of clarification.

6.1. Of Metaphor

Metaphor can be further divided into visual and gestural categories, art being of course the most obvious use of visual cues for immediate emotive response as well as cognitive understanding. Design relies on systems of semantics, the use of symbols to carry meaning, a subject of great scrutiny by interaction designers. Of course, it is well known within HCI circles how Apple took the metaphor of the physical desktop to redesign the interface of the computing tool, and make it the personal computer. By clothing the technology in recognizable interactions the computer became approachable by non-experts. An over-dependence on universally understood indicators alone, however, results in homogeneous products, and the loss of all delight through creative surprise, and should therefore be treated with caution. Another approach is through familiarity with actions or gestures. These are naturally beginning to receive more attention with the growth of mobile and embedded systems, but are not entirely new; with what appears to be great foresight, Jean Baudrillard, the French philosopher, wrote in 1968 that there was no human gesture left that could not be replaced by technology [25]. IDEO's recent concept design for a nano-technology mobile phone exemplifies the approach, relying on the familiarity of the gesture we use to mimic making a call to make a very novel design easily understood [30].

6.2. Through Material and Form

Materials, as well as form and visual language, carry a strong affective charge. An attempt has even been made to plot a multi-dimensional map of the aesthetics of materials by their tactile, optical, and acoustic attributes [31]. They have a personality separate from the forms they hold as products, and are commonly perceived to embody values such as nobility, authenticity, warmth or cleanliness. A good example is that of stone, which might be seen as being more 'authentic' than concrete [25]. Could it be that materials which have become fixed in our collective consciousness over a longer period of time are those we deem "authentic'? From our brief look at the philosophy of familiarity, we might assume that by having manipulated these materials over a longer period of time, mankind has acquired a deeper tacit knowledge of them, or Heideggerian understanding, and thus feels a greater connection with them. Those that have fallen out of use, at least in Western building, do not, however, enjoy the same status. In their paper for the Arup Journal, Cardwell, Cather and Groak classify materials by an engineering understanding of their properties [32]. These classifications are familiar, unfamiliar, unknown, unknowable and contemptible. Contemptible covers those materials which have fallen out of use, having been

superseded by technological advances, and include such things as lime mortars. Of course, this type of material can also carry an affective charge, and demonstrates nicely how this kind of value judgement, like all others, is dependent on context - around the same time as this paper was published, DIY books and popular television aimed at middle class consumers were espousing the use of limescale to achieve a rustic effect. From a crafts perspective, however, the maker's familiarity with a material, gained through the concrete interaction with it over time, has the power to change this type of value judgement. If we accept that the object may act as a meeting place between maker and user, then an increased understanding on the part of the maker effects an increase of understanding on the part of the user, and if 'authentic' materials are those we understand more deeply, then the status of the material is subsequently increased through the building of praxis. Take for example, acrylics. A very young material in comparison to say stone or metal, this material can become invested with value through manipulation. The jewellery and objects of Adam Paxon are a case in point. These artefacts explore the boundaries of the physical and aesthetic properties of the material by thermoforming and laminating layers of coloured acrylic sheet [33]. The results are humourous, mysterious and delightful, distant poetic relatives of the 'cheap and cheerful' use of this material in many mass-produced products.

6.2. Preconception vs. familiarity

Finally, there is an important distinction to be made between preconception and familiarity. While preconceptions may be reassuring, familiarity is not a cognitive process in the way preconception, by its very nature, has to be. So, if we suggest the material gold to a group of users, we may find the expected connotations of wealth, success and long lasting value. But if we look at this material in the hands of traditional Paduan goldsmiths of Italy, it embodies very different qualities to these – here, it is frequently alloyed by hand, creating subtle differences in colour from maker to maker, and very rarely polished, but given instead a matt finish, softening the appearance. Now gold is warm, soft and intimate, and not in the least ostentatious. It is still familiar, but the familiarity is more powerful for the discarding of preconceptions. Many writers mention honesty in the use of materials, a legacy of Ruskin and Morris, as a restrictive ethos. This says that materials should be used for their intrinsic properties – iron should be forged for its strength, not cast, which makes it brittle. But craftspeople, as the goldsmiths show, play an important role in extending the language of materials, and in exploring the limits of their properties. What is interesting for us now, is the concept of the craftsperson in the world of engineered materials. What happens to familiarity when materials are constructed to order at a molecular level? Whether familiarity can be conserved or introduced through the design process is one of our main research interests.

7. Conclusions and Further Work

We have seen then that wearable computing artifacts represent special problems for the designer in terms of their intimate nature, and that the current movement within product design towards the design of pleasurable products may be a promising way of addressing this. Electronic products generally are at the moment changing from tools into objects with more personal meaning, and wearable developers will need to understand this aspect of the market to ensure a successful personal product. Taking into account a Heideggerian approach as found in crafts practice increases the aspect of familiarity within the development process, and as a result, the feeling of familiarity as experienced by the user. We plan to research this supposition through a design-based methodology, that is, while usability is of course important, form will not necessarily follow function. Instead, elements of functionality will be taken from a user centered requirements generation exercise upon which to base a series of conceptual wearable artifacts, built as far as possible using crafts processes, and exploring different materials and their affective charge.

7.1 Proposed Method

Thus the research will make use of a range of methods, combining elements of usability engineering within a design through making approach. The target user group will be visitors to the Edinburgh Festival, a large arts festival representing a complex temporary information space and a myriad of different social environments for the participant. Users will typically be interested in the arts, and many will have little or no knowledge of the geographical layout. Most will want to meet friends, but also make the most of serendipitous meetings, and to both prearrange show bookings, and have access to current contextual information, perhaps about ticket status or show cancellations etc. Pre-questionnaires will be used to determine the level of participants' ease with technology, and initial requirements generation will be done via questionnaires and focus groups during the Festival this August. This is also expected to highlight any possible issues the target group may have with mobile technologies, for example visibility of use or privacy, and participatory sessions based on the Future Workshops techniques of Jungk and Mullert [34] will be used to elicit creative ideas, hopes and fears regarding wearables as a paradigm. Meanwhile, other participants will be

interviewed about two types of artifacts they own, and which hold some kind of meaning for them: worn items, and technology products. These interviews will be conducted on the street and in the home, as it is expected that participants out and about may be more concerned with mobility and social interaction, while those in their own home are expected to feel more relaxed about the interview process. The benefits and experiential properties mentioned in these sessions will then form the basis for a series of design sketches, and participants will be asked to rate the design concepts according to these properties. It is expected that a number of tradeoffs, such as usability against an element of delight, will be exposed, and these continuum will be explored through prototyping; this stage will also investigate issues such as the familiarity of materials. Finally, working prototypes will be built, and empirically tested for their familiarity, usability and the benefits described in the participatory design sessions. It is hoped that we will be able to include electronic and sensing fabrics in the testing, and to present the results at a later date.

8. Acknowledgements

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