Pragmatic Aesthetics as a Design Resource for Proactive Information Technology

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Abstract. The majority of microprocessors in the home are not found in PCs but in objects like toasters and toys. The number of microprocessors and sensors will continue to increase radically. Controlling this technology may become increasingly difficult and time-consuming. The notion of "proactive computing" claims that increasingly, technology ought to take the humans out of the loop: technology ought to act on its own. The question is how to design this revolution in a way that people can accept and enjoy it. This paper studies how pragmatic aesthetics can be used as a design resource. We have built four minidesigns and installed them to several homes, interviewing and photographing users' responses to these designs with scenarios. This paper described the roles in which aesthetics appeared in these user studies and discusses design implications of adopting a pragmatic framework.

1 From Ubiquitous to Proactive Computing

Over the last 30 years, information technology has increasingly spread into our everyday environment. Personal computers have become icons of modern information technology, but they contain only a small portion of our processors. Most processors exist in other technological equipment: toys, mobile devices, alarm clocks, thermostats, ovens, and toasters. This is what Mark Weiser [1] observed over a decade ago, coining the term "ubiquitous computing" to name that phenomenon. Although his basic observation is no doubt true, ubiquitous technology has had little commercial success. Still, it has become an increasingly important area for design, spreading from such electronic products to furniture, and to spaces and environments [2].

Partly overlapping with this idea is the more recent notion of "proactive computing," first introduced by David Tennenhouse [3]. He observed that as the number of IT devices in human environment increases, people cannot possibly control all of them if they are designed according to the desktop computing paradigm. Humans have to get out of the loop: devices need to be designed to take action without human intervention.

The main difference between these notions is that the former claims that information technology has spread into the environment, while the latter captures a more challenging idea from the point of view of interaction design: information technology must sense human actions and react accordingly [4]. However, in its general thrust Tennenhouse's notion is an elaboration of Weiser's observation concerning ubiquitous computing. A proactive system is integrated into existing material objects in the human environment, which may function independently, or exist in a (wireless) network. According to these visions, proactive technology is typically "calm," barely noticeable [5]. Ultimately, such systems could be adaptive and over time learn new patterns of behavior and response.

However, this brings design close to the familiar science fiction nightmare of technology taking over. If people feel that they cannot control technology, they may come to see it as something running amok, making the home feel uncanny, unsafe and alien. Following the writer Isaac Asimov, fears of technology running wild have been called the Frankenstein syndrome [6: 205-248]. The notorious HAL in *Space Odyssey 2001* provides a vivid example.

It is here that design plays a crucial role. If information technology is embedded into objects such as pillows, sofas, tables, chairs, not to mention ceilings and walls, it easily clashes with conventional uses, and sometimes even affordances of these objects [7, 8, 9]. People expect that these objects function in certain, traditional ways. If these objects come to have new functions based on information technology, people may experience such environments as unsettling and unpleasant as their own, traditional methods of action fail to anticipate the behavior of the environment. Surprises, frustration and anger feed suspicions about technology's usefulness and harmlessness, degrading the user experience. Designers have to give people something in return: this paper explores how aesthetics could be used as a design resource for designing proactive technologies of the future.

2 Aesthetics and Design

The design question that follows is how can designers use aesthetics to communicate the fact that culturally conventional objects and things have new, technology-induced uses? Further, do users understand that intelligence and control functions are not in a centralized control panel or remote control device but embedded in the environment?

This paper investigates this question through pragmatic aesthetics [10] and with a series of design studies in Finland, where we have probed this question by building a series of mini-designs [11] that function as experience prototypes [12].

In a recent paper, Graves Petersen et al. [10] point out that aesthetic judgements are grounded in socio-cultural structures, not in "emotive aesthetics" linking emotional experience and aesthetics, nor in "aesthetics as appearance," that equates aesthetics to the qualities of objects and professional judgement:

> The legitimacy of experience o the system is not confined to be in line with the intentions of the designer or the system, but emerges from the personal and interpersonal sensations, experiences and reflections that are connected to the system in context. It does not regard man and world as separate things but focuses on the integration and interrelations bound to context. Designing for aesthetic experiences invites people to actively participate in creating sense and meaning… it is about triggering imagination, it is thought-provoking and encourages people think differently about the encountered interactive systems, what they do and how they might be used differently to serve differentiated goals. [10: 3-4].

In our previous, explorative work, we have been working with an IKEA-type lamp that has been used as a "mini-design" for studying proactive design ideas [13, 14]. We installed a lamp with proactive features in two homes in Tampere and Helsinki, and conducted interviews in 12 homes about two weeks later. The minidesign was built to be stereotypical: it was built into an existing IKEA frame. Technology was fitted into the lamp, but a control panel was added. The design was planned to be as neutral but also stylish and as commonly accepted as possible. We learned that:

- At home, people expect to be in control of technology rather than vice versa – which is the case of the workplace, in which management can introduce technology at will and expect consent, if not compliance with its decisions.
- People accept certain classes of technology more easily than others: ambient technologies such as lighting and central heating do not cause problems [15]. Also, people are willing to delegate dirty work – like cleaning – to proactive technologies.
- People do not like technology that gives other people cues about their actions (exceptions are found in studies on communication and telepresence, e.g. the concept Sixth Sense by [25]).
- Design is all-important in terms of how proactive ideas are accepted at homes. For example, when lamps are designed in an IKEA style, proactive technology becomes less scary even if the electronics are visible.

This paper reports a further development of this study with more lamps that vary in terms of design. This time, we created four lamps that deliberately varied aesthetic style. We contrasted the IKEA lamp with:

- One lamp that was barely more than a bar of aluminum.
- Another that followed what we called the "granny style."
- A third with an grotesque, futuristic lamp aesthetically closer to the *Alien* movies than to standard lamp design conventions.

The logic in this selection of designs is based on an idea from pragmatist aesthetics. If we create designs that break users' ordinary aesthetic conventions, people pay attention to these designs, think about technology and discuss it. Especially when a design challenges ordinary aesthetic sensibilities, possible suspicions about technology also come to the fore. The soothing – or almost seductive – "IKEA effect" observed in our earlier study [14] is avoided. From a design standpoint, this is desireable: new technology gets attention not just because of its behavior, but also because its aesthetics are odd enough so that users cannot rely on their culturally conventional uses to interact with proactive technology.

3 Data and Methods: *The Four Lamps Study*

This study has proceeded in four phases. In the first phase, we studied a series of homes in the cities of Tampere and Helsinki with a probes methodology to learn which areas of home life could be suitable for proactive designs. In particular, ambience – soundworld, lighting, smell – came out as suitable topic for subsequent work [14]. In the second phase, we created a minidesign from a pair of cushions partly for testing wireless technology and the robustness of the technology, partly for getting an initial idea of whether a simple proactive technology would make sense to people at home. For the third phase, we built a lamp with several functions that mimicked proactive behaviors, such as changes in light intensity over time (see Figure 1).
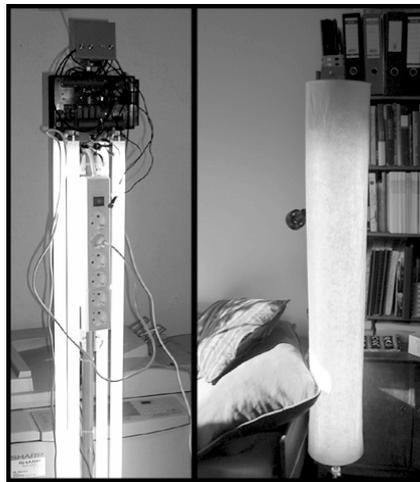

Fig. 1. The Lamp: Electronics and Its Four States. The lamp has four states. [1] A normal lamp with button for adjusting light; [2] a 10 minute cycle in which colors changed from warm to cold; [3] a sensor designed to keep light constant in the lamp's surroundings [4] a state in which red and blue LEDs reacted to sounds. It was also possible to attach other electric devices to the lamp. The lamp had four 36 watts light tubes (2 colored, 2 normal).

This paper focuses on the fourth study. For this study, four lamps with varied designs (Figure 2) were built to see whether design makes a real difference. The lamps reacted to sounds by changing colours from blue to red trough green colour according to the volume. The blue colour marked silence while red indicated the highest noise level. The changes between the colours happened smoothly (also by the help of light intensity) even though the response of the colours changes was real-time. The lamps had a normal on/off switch. When they were on, they were always on the "proactive mode." There was a button for adjusting the rapidity of the feedback, but that function was used rarely by people. Only the Ikea lamp could be used also as a normal lamp, i.e. proactive behavior could be switched off. However, people kept it on a proactive mood rather than used it as a normal lamp.

IKEA: Hides technology by covering it with a stereotypical modern taste.

Glow: hidden into a steel bar, LEDs illuminate a room by reflecting light from the ceiling.

Granny: hides technology by covering it with a traditional granny lamp design.

Giger – a futuristic design: the aesthetics of this lamp is deliberately out-of-place in most homes.

Fig. 2. Designs in the *Four Lamps Study*

In a user study we will have four homes in total but when writing this paper only half of them have tested the minidesigns. These two homes composed of four persons living in two-room flats in apartment buildings in Tampere in Finland. In the first home, a woman and a man in their twenties lived together; the other home (home 2) to

a middle-aged mother and a 16 year-old son. Both homes had diversity of media technologies but not a landline telephone. All of the participants named television as the device they use most together at home. Three of the participants considered a computer as the most important device when being at home, but one prioritized a CD/DVD player: there is nearly always music playing in the background in her home.

Lamps were installed to households one by one, not all at once. A new lamp was installed after a week's interval. The families were interviewed for the first time when the first lamp was brought to them. They were asked e.g. about their attitudes towards lighting, sound world and computing technology embedded in furniture. They were also interviewed shortly during every lamp installation. And finally, when the last lamp was picked up, we had a concluding interview about user experiences and ideas emerged during the whole test period.
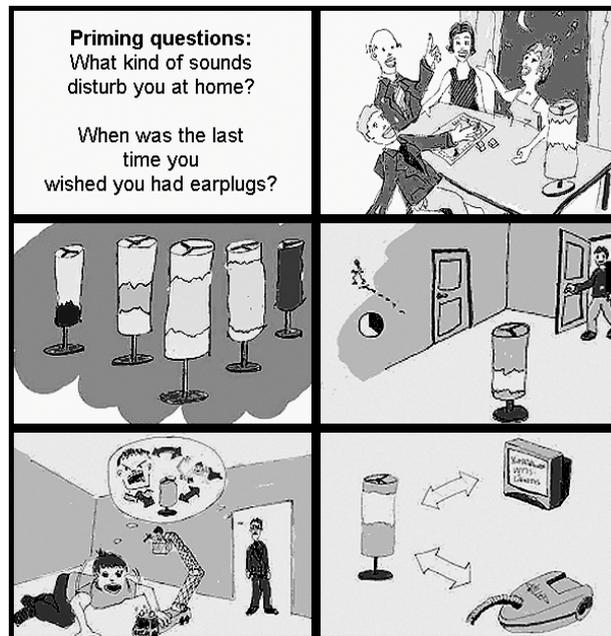

Fig. 3. Examples from Scenarios. Up: the priming question sent a week earlier, the sound world of the home (preparatory question); **Middle**: the lamp reacting to sound, *Memory Trace* (lamp that remembered who had been in the room, and communicated that to newcomers); **Down:** the lamp in social context, the lamp as a control to other technology. (c) Kristo Kuusela

Lamps were more than just things to be tested. In our initial studied, people feared technology that would take action on its own, which was reflected in interviews as unwillingness to accept such technology. To break this "Frankenstein effect," minidesigns were installed to homes to give people at least an idea of proactive technology. However, it is important to understand that our study is technologically not advanced enough to put Tennenhouse's proactive vision to a true test. Therefore, we supplemented our study with scenario interviews. We embedded the lamp designs into

a scenario describing five types of context (see Figure 3). With scenarios, we probed the limits of acceptable technology. The interviewers' questions were used to maintain discussion rather than direct it in detail.

In our user study, we have followed an interpretive procedure typical to qualitative social sciences [16]. Although we have studied a technological vision by building minidesigns, our study has studied this vision through user responses. From the pragmatist perspective [10], aesthetic human reasoning is always tied to specific life circumstances. Therefore, we analyze our user data by explicating variations in aesthetic perspectives rather than by testing a set of predefined hypotheses. The analysis proceeded by searching for aesthetic statements from transcripts of interviews and photographs, making a collection of these statements, and then classifying this collection into main aesthetic variations. In next sections, we report the most important of these remaining variations.

4 Two Orientations to Aesthetics

In the homes studied for this paper, several aesthetic orientations coexist. In the first home, aesthetics played an important role in all stages of life of the product. For example, when we inquired early on in the interview about what kinds of things the couple pays attention to when they buy lamps, they told us the following. (A. refers to the interviewer).

A: Ehm, when you're buying a new lamp or light source, what things affect your decision?

E: To me it is important that it looks nice (laughs shortly), and that I know there's a place for it.

A: Yeah.

I: Me too, I choose on the basis of its appearance. Of course, I also think about its purpose... but it is mainly appearance that matters.

In particular, if an item seen as a decorative element, appearance played a crucial role in not just the purchasing situation and thinking before that decision, but also in how it was used. This was regardless of whether the item was electronic or a traditional interior decoration item.

In the second home, interviewees relied on the rhetoric of utility and function rather than aesthetics to describe their relationship to the minidesigns. They also understood them as measuring instruments rather than decorative elements.

A: What about when you are acquiring a new lamp or other light source, what kinds of things you take into account?

T: Ehm, well, it is utility before anything else. If we're talking about an item for lighting, I've not done quick decisions for years anymore (laughs). I don't believe I'd buy a lamp I didn't need no matter how beautiful it was.

However, when we pointed out that there are different types of lamps – like lamps in the ceilings vs. on desks or on floors – and asked about differences in acquisition and use, these criteria changes somewhat: "OK, of course the appearance matters in the final instance when you are buying it." And later, when talking about a new television, "It is good that it looks good. However, appearance is not the most important quality, it is just that I wouldn't buy something that looks ridiculous."

In both homes, interviewees made a distinction between fashion-oriented objects and more classic objects that hold their aesthetic value over time. Also, there was a division of labor in decisions about interior decoration in both homes. In the first home, the division of labor was gendered. I. told that "I'm totally out of touch with interior decoration. OK, I know when something looks fine and when something doesn't, but I can't say what it is that makes this feeling (laughs). This is why I prefer to let someone who knows to make decisions in interior design questions (laughs)", referring to his girlfriend. In the second home, this role distinction was based on parenthood: the son told that "it is her who makes decisions" about acquisitions to the home.

In both homes then aesthetics plays a role when people consider what is acquired. However, the priorities are different between these two homes. The first one pays attention to aesthetics first, and then thinks about utility; in the second one, form follows function. The interviewees are consistently talking about aesthetics as a pragmatic thing: aesthetic reasoning depends on current needs and wished and constellations of other objects at home. For instance, they use words like "looks" in describing their aesthetics, and equate aesthetics with "beauty." These are lay terms typical to the aesthetics of ordinary life, not categories of learned discourses.

5 How Were Aesthetics in Designs Interpreted

Our expectation was that our aesthetically varied designs would challenge people to give attention to lamps, forcing them to think about technology behind the appearance. This reasoning held to an extent. As Table 1 shows, the lamp designs found their place mostly in the vicinity of the television. Out of eight placement decisions, six led to this position. Also, one lamp was transferred from one place to another over the study a week.

As such, this result is anything but surprising. A good deal of domestic technology finds its place not far away from the television. For example, Figure 4 shows that where there is a TV, there is also a video and DVD player, a digital receiver, and – in home 2 – a record player. Also, a TV light is typically found at Finnish homes for

historical reasons. In the sixties, medical experts told people to avoid strong contrasts of light when watching television, and place a lamp either behind the device or into its close vicinity. The aesthetic import of this placement is that next to TV, lamps could not escape attention.

Table 1. The placement of lamps into homes

Lamp	Home 1	Home 2
IKEA	Next to TV	Next to TV
Glow	Upon a CD tower, close to TV, but pointing towards the wall	First next to TV, later upon a book shelve away from sight
Granny	Side table with miscellaneous and kitchy objects	Next to TV
Giger	Next to TV	Next to TV

Why the pattern was so strong? The first reason is architectural. Both homes are small, and have only one natural place for the TV: a small living room, which offers only a few options for arranging the interior. Also, both homes are small, which gives people only a few working alternatives. The lamps were suitably sized, and they had a cover that gave them a TV lamp feeling.

E: The whole living room is a problem. It is impossible to place furniture to it in any sensible manner (laughs). I like to switch the order of things in it, and I have tried to think about changes here too, but I don't really come up with alternatives here. So far, I haven't found any other solution to the living room. That's why the TV went into that place.

I: Yea, really, you can't reshape the living room with furniture because it is a difficult space. But anyway, I'm pretty satisfied with the current way in which furniture is placed. But it is really difficult to invent alternatives.

The second qualification gives a more detailed picture of what happened to our designs. Note that two placement decisions in the first home did not follow the TV-dominated pattern, and the *Glow* migrated in the second home away from the TV.

A closer look at Figures 2 and 4 gives cues about the reasons for these variations. As Figure 2 already showed, a small man made of white iron wire (head notwithstanding, a Giagomettian figure), was placed to the root of the lamp in the first home, transforming the lamp into a tree-like object under which people can sit. The lamp became a focal point around which people place similar kinds of things. Figure 4 shows that in the first home, the *Granny* was placed next amongst a collection of kitch-like items: a green glass jar, a dinosaur-looking piece of ceramics, and an old-

looking, white candle-holder manufactured with a lathe. It goes with these objects. Next to a modern painting, it would have been a style gaffe.

Further, Figure 5 shows that in the second home, the *Granny* lamp was also placed out of a premium position to the side wall, where it acted as a light source. In this position, the *Glow* created a light effect, and functioned as an ambient element. It also highlighted a modern painting next to it.

Figure 4. The *Granny* lamp in two homes (home 1 above; home 2 below)

It is important to note that these placement decisions were done quickly. In our interviews, people were typically not able to give detailed explanations about why they placed lamps into certain places. However, their actual choices tell about aesthetic choices. For example, things around the television also make a prime location in the aesthetics of the home. Even though social intercourse has been moving into the

kitchen among younger people, post-war Finnish homes do not make such move easy without an extensive – and an expensive – rebuilding of apartments. The living room – and television in it – remain at the hub of social behavior.

Figure 5. The *Glow* lamp (home 2)

Also, corners and tabletops are more than abstractions at homes. They are made into specific kinds of places in part by placing things and objects into space. Just as religious homes have home "altars," non-religious people may build memory "altars" from photographs and tourism memorabilia. Many homes have home offices, and teens have PC corners for playing computer games. In the first home, the coarse iron man next to *Giger* tells how this lamp was classified as an art piece of some kind. In contrast, the placement of the *Granny* reflected not just the need for light in the side table, but also other memorabilia placed on it.

6 Aesthetics: A Limit or a Resource for Proactive Design?

The probes study early on in Morphome led us to focus on designing ambient elements like soundscape, visual environment, and lighting instead of trying to build predictive systems [17]. In our earlier study [14], we learned that with aesthetically pleasing designs, people can be seduced to accept technology even if they would have doubts about it. In the *Four Lamps Study*, we broke this assumption deliberately with more varied designs with the aim of posing aesthetic problems that would demand attention to design and technology behind it. This breach was deliberate, following an old design convention that advised us to change design if a product has new or unanticipated functions.

The design aim was successful. No "IKEA effect" was observed. However, proactive features perceived positively after people had experienced proactive thinking by interacting with our minidesigns. In scenario interviews in the first home, we were told that this would be the case. Here talk refers to specifically to lamps reacting to sound levels:

A: What would you think about an idea that some object at home would give you feedback about the sound level of the home?

E: Wasn't that the idea in the lamp (laughs)

A: Yes, it was.

E: I had a crush on it... so that for instance if you could with lights or something else [get feedback, authors addition], it would be really nice, not a necessity, but a nice additional feature

I: Me too, I thought it was an exhilarating idea, and interesting. I'd take it with interest

People in the second home developed a similar stance, although they voiced it differently by evoking a stereotype. They claimed that doubts about technology are typical to seniors citizens and women who have attitudinal and learning-related problems towards new technologies. These problems are not rational ones and wane over the years just like initial opposition to plumbing hundreds of years ago. Specifically, the mother of the family related her positive stance to her technical background and occupation (she works in PC support).

In particular, people would like to delegate a few tasks to proactive technology. Their list consisted of taking care of trash, security systems, insurance policies, and house cleaning. Also, the management of lights could be delegated to proactive technology. Similar ideas are typically voiced in user studies of smart homes [14, 15, 18, 19].

Still, important technological reservations were voiced too. For instance, the mother of the second home noted that it is hard to imagine well-functioning predictive technology in any specific context. To make technology specific enough, it would have to know *her* corners, *her* table, and *her* preferences. Her son remarked that he has fairly few routines anyway, which would make prediction hard. The third doubt targeted systems: people would not like to live in a systemic environment in which the failure of one device leads to failures in other devices. The system ought to be sufficiently partitioned to safeguard against such domino effects. Similar concerns have been voiced over and over in studies of smart homes [15, 17, 18, 19].

Some of these restrictions are aesthetic rather than technological. In the first home, our question about how to embed proactive technology to the environment led to a discussion about antique.

I: Eh, the only thing I can think about where I wouldn't like to have such technology is something like an old grandfather's clock. It's the point of

the clock that it comes from another, older, era. Modern information technology would ruin that basic idea…

Soon after, I. qualified that one can certainly design a new object using an old style as long as it is easy to see that it is a modern object that is just designed with an old style. As an example of such situation, he mentioned retro-designs in refridgerators and other electronics, as well as the modern classics movement in antiques (i.e. designer objects from the 1950s-1970s sold as antique).

Another aesthetic issue related to the way in which proactive technology is controlled. In both homes, people wanted to have a switch off –button that could turn off the whole system in case of accidents. They also wanted to have a control over technology: with exceptions mentioned above, they preferred a technological vision in which devices propose actions and ask confirmation from people before they commit them. However, the way in which such acceptance procedure would be implemented was a critical issue in the first home.

I: I think that people do not like the idea of an acceptance [procedure, writers] is that the present procedures in IT are so disturbing. To do thing properly, you have to stop whatever you are doing. But such acceptance would be nice if it'd be non-disturbing and easy to use.

E: Of course the whole point of automation loses its meaning if you have to go to the machine to accept it.

In other words, control dialogues in current computer interfaces are "ugly." Designers of proactive technology ought to think about how to utilize more imaginative methods of interaction in implementing the proactive vision, such as movement, games, and perhaps tangible "phicons" [2, 20, 21]. Again, some aesthetic judgements are available for analysis in actions rather than in explicit thought models [10]. Action does play a crucial resource in designing interactions with proactive IT.

7 Design Implications

This paper has described a design case study of how aesthetics functions as a resource for designing proactive design. The following lessons can to be learned from the study:

- Aesthetics plays a part in how people understand accept technology to their homes. If it is not given due notice, it remains an unobserved variable whose consequences, in the worst case, are mistakenly attributed to other factors. Aesthetics must be taken seriously, or it may work against the aims of technology development.

- It can be understood in pragmatic terms [10], not in terms of inner qualities of objects, emotional judgements, or academic theory.
- It may offer not just ideas, but also guidelines for an interpretive methodology for designing new kinds of technologies.

To study aesthetics from a pragmatist perspective, one needs to do at least three things.

- First, aesthetics has a social and cultural structure. Aesthetics is not as important to all people, nor is it understood in the same terms. To study aesthetics in pragmatic terms [10], one needs to study how people define certain things as valuable in terms of aesthetics. What kinds of classifications and categories people use in defining things as aesthetically valuable and not? Who makes decisions at home? Is there a division of labor?
- Second, in studying how aesthetics functions, one needs to go beyond of what people say in interviews. In many cases, aesthetic decisions are done by just experimenting rather than by thinkingly. Pictures or designed objects are needed; room maps add to understanding; activity maps of homes help to understand the structure of the home. Often aesthetic perspectives are evident only in ways in which things and technical devices find their places in homes among other things.
- Third, one needs to study how aesthetics poses limits to what is acceptable in technology and what is not. Lessons can be learned from work on tangible interfaces [20, 21] and embodied interactions [22], where research has explored ways in which body movements, sound, and gestures can be used to control technology rather than more traditional control panels and browsers.

In design terms, we suggest that it is important to iterate constantly with varied designs and collect responses from people. A user study is a good way to open up imagination. Pragmatic aesthetics needs to be studied *in situ*, by experimenting, interpreting, and by learning how people conceptualize, categorize and order their world and opinions, not by relying on modernist aesthetics or researchers' own concepts. How to create tangible, visual, and aural interfaces that would respond to concerns like those voiced by people in our study?

8 Discussion

David Tennenhouse's proactive vision of information technology holds a promise of technology that could free people from a need to control it. As we understand the notion, it provides an important extension of Weiser's notion of ubiquitous computing [1]. However, so far the proactive vision has not gained much spread in the marketplace, partly for technological reasons, partly for reasons that are familiar to those met in ubiquitous computing [23, 24] and smart homes [15, 18, 19]. The vision of a "calm" technology is not enough.

In this paper, we have described an attempt to introduce Tennenhouse's vision to two homes. Specifically, the focus has been on aesthetics as a possible design resource. We believe that we ought to treat aesthetics as a "fact" that shapes human action and, in consequence, the ways in which people adopt new technologies – or discard them. Not paying attention to aesthetic issues poses a risk for any design attempt, especially if technology is embedded in ordinary objects rather than traditional computers.

In Weiser's and Tennenhouse's visions, technology is embedded in existing material world. The problem is that existing objects have conventional uses that guide they way in which they are used. A traditional design principle says that if objects have new functions they should communicate that to the user somehow. In such communication, aesthetics offers a versatile and powerful resource for designing new technologies.

However, our understanding of aesthetics is based on the notion of "pragmatist" aesthetics as outlined by Graves Petersen et al. [10]. From this perspective, aesthetics is always situated to specific circumstances and judgements people make from their particular perspectives; aesthetic judgments are not done in abstract on appearances, nor are they based on emotional attributions.

The notion of pragmatic aesthetics provides also a powerful methodology for studying aesthetics in two homes in Tampere, Finland, and for turning these insights to design resources. We have created a series of four lamps that react to sound variously by changing their intensity and color. This paper has focused on their aesthetics rather than technical design. We learned that aesthetics is an important element in how people understand technologies. To study pragmatic aesthetics properly, one needs to build a series of mock-ups, minidesigns, or prototypes with varying designs, let people use them, and make iterative designs. In such study, at least three things need to be held in mind:

- People develop various perspectives on aesthetics.
- In many cases, aesthetics judgements are "silent," available in actions rather than in explicit thought models or explicit reasoning. To study aesthetic judgements properly, one needs to go beyond interviewing to visual methods to see how people place things into their environment.
- Aesthetics is setting specific: people vary in how much stress they put on it, and whether they see it as a restriction, or a resource in accepting designs.

In our interviews, most talk was about the aesthetics of the home and minidesigns, not about aesthetics related to interaction [10]. We believe that this is a methodical problem that relates to our choice to work with lamps. Even though the lamps changed their state by reacting to sound (which is induced by humans), people did not describe whether and how they changed their behavior in response to changes in light intensity and color. Like sound [26], light is ubiquitous and abstract, and it affects human moods and actions in multiple ways. Consequently, people are badly equipped to observe – and hence report – their interactions with it. To get at how people interact with our minidesigns, we built into an early control circuit a port for a video camera that would record action when it senses movement, but faced insurmountable technical

problems with image quality. We also figured that participant observation was too obtrusive and inefficient a method for studying private homes. This led to a necessity to rely on interviews, which may lead to a bias in our data: a conventional way to talk about aesthetics is in terms of meanings rather than actual practices [27]. We do not have access to the embodied, practical grounds of aesthetic judgements as they evolve in ordinary interactions of people with our minidesigns.

Our work continues. We are building a hybrid environment [2, 10] in which digital content and physical objects intermix with proactive interfaces.

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