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EXPERIENCING PRODUCT USE IN PRODUCT DESIGN

Stella Boess
Delft University of Technology

ABSTRACT
How people use products can be quite different from the expectations of designers. This has been shown during the last twenty years, highlighting the need for designers to engage with product use while designing. Many recommendations have been made, for example on a conceptual level, semantics or, on the process level, usability assessment methods. So how do designers try to anticipate how people will use their products? An interview study with ten practicing designers was conducted. It asked how the designers try to aid that users are able to access the functionalities products may offer, and how the designers check whether the users really can and want to access these functionalities. The following issues emerge from the study. Designers see it as their competence to anticipate product use, based on intuition and professional experience. Designers could benefit from tools to deal with this aspect more explicitly. Furthermore, product use can get crowded out of product development because its characteristics are not always made explicit. Partly, these aspects can be addressed at an organizational level. Partly, tools and solutions can be based in activities designers already do.

Keywords: Experience, product use, interview study, design practice

1 INTRODUCTION
How people use products can be quite different from the expectations of designers. A body of literature showing this has emerged in the past twenty years in design. For example, Suchman [1] observed that users of a copying machine acted in ways unexpected by the machine's designers. The machine was supposed to support the users in their activity, but this often failed because the machine was unable to detect the users' actions. Suchman's study was one of the starting points for a discussion on what product use actually entails and how it can be addressed in design. It also contributed to the emergence of a user-centred approach to human-computer interaction in [2].

Krippendorff and Butter [3] argued that it can no longer be assumed that it is possible to force "correct" usage of products onto consumers. There is great variation and indeed creativity in the ways that people make sense of things. This is now being discovered in the design field, and various names are being given to it: for example "Thoughtless Acts?" [4] "Non-Intentional Design" [5] or "Wild Things" [6]. The terms seek to challenge the still prevailing idea that design is the exclusive domain of professionals. Design is also in the way people use, adapt and appropriate things. Kanis [7] noted that there is a great deal of variation in the ways people use things, requiring careful observation of product usage in order to make inferences for design. In order to try and convey this need for observation, Kanis et al [8] and Boess and Kanis [9] presented an alternative concept to the concept of affordances which had become to broad and general: the notion of 'usecues'. It emphasises the users' attribution of meaning to products and the situatedness of human-product interaction. From this view, it follows that the design activity needs to be closely connected to observational studies of product use. But is it? How close are designers to the activity of product use while they are designing?

Suchman [10] reflected on a long period of experience with various corporations and noted that testing during product development was more often a matter of intentions than of real strategies and actions. Yet much has been done to show that there would be benefits in looking at product use and its problems directly. Over the past twenty years, it has been demonstrated in various ways that there is a gap between presumed product use and real world product use. Perhaps Norman and Draper [2] were

the first to put this argument strongly in product design. Krippendorff and Butter [3] and Green and Jordan [11] suggested that consumer choice is leading to greater demands on design quality and usability. And yet, recent studies suggest that companies still do not take into account the consumer perspective on product (use) quality and reliability [12].

Research approach

The research reported here studied what terms and concepts designers of consumer products use to refer to *meaning in product use* in their work, and it looked at the ways they work to aid that users are able to access the functionalities products may offer. Finally, it looked at how the designers check whether the users really can and want to access these functionalities. The research approach was that of a small-scale but in-depth interview study with practicing designers.

The research draws on the approach of ethnomethodology. "Ethnomethodology gets at the norms, understandings, and assumptions that are taken for granted by people in a setting because they are so deeply understood that people don't even think about why they do what they do." (Patton [13], p. 111).

It has been shown previously that for example in work situations, people behave differently than they are expected to do. Yet they seek to make sense of their everyday activities in socially acceptable ways. They manage their activities with reference to the ways things should be done and with reference to the demands of situations. There can be considerable gaps between these two frames of reference. CSCW studies, for example look at what happens in these gaps (e.g. [1]). This is also the basic approach taken here. In terms of data collection, a well-known ethnomethodological approach is to conduct breaching experiments, in which norms are violated and the results observed. This is not the only possible method within this approach, however. "Ethnomethodologists elucidate what a complete stranger would have to learn to become a routinely functioning member of a group, a program, or a culture. To do this, ethnomethodologists conduct depth interviews and undertake participant observation." (Patton [13], p 111). This was a study with busy professionals in a variety of organizations and settings, and who did not have anything to gain from the research. Participant observation was not a feasible strategy. In-depth interviews were selected as the method. The interviews took place at the workplace of the designers and were focused on concrete design projects that the participants had recently done or were in the process of doing. The interviews took these concrete projects as the starting point for probing into the motivations and rationales the designers had for decisions they made or their assessment of certain design outcomes. That way, it was sought that the interview study would be based on the everyday activities of the participants as much as possible, and not on pre-formulated questions that the interviewer posed. The only steering aspect of the interviews was to keep probing beyond the level of normal conversation particularly when the usage of the products was at issue. This has a similar function as a breaching experiment. It forces people to explicate some of their tacit knowledge and to try and make sense of their own explanations.

The research had two main research questions:
- how the recommendations are present in the designers' talk, and what alternatives they themselves use, and
- how designers respond to the work situations in which they have to deal with meaning in product use.

This paper reports on the insights related to the second research question. Boess [9] reports on the first research question.

In [14], I reported how the designers in this study refer to meaning in product use, which terms they use and how they use them. It was reported there that meaning in product use has many terms for the designers, but not necessarily the ones recommended in the literature. Semantics and affordances were little known and used, whereas communication, conventions, discovery and physicality were concepts that the designers used in the descriptions of their work. The paper concluded that a greater theoretical focus on dynamics, contextuality and physicality would be of help to the designers. Furthermore, techniques to aid the designers' preference for concreteness might be helpful. Such a focus and such techniques may enable them to consider meaning *in product use* more explicitly, as opposed to

designed, intended meaning. In this paper, we investigate the activities that the designers said they carried out in relation to product use. How close do the designers actually come to product use in their design process? In how far do they experience product use during designing?

2 RESEARCH

A study was conducted comprising ten interviews with designers in the Netherlands that included independent designers, designers from small design firms and designers from a large, internationally operating design consultancy. The interview procedure, questions and analysis are reported in more depth in Boess [14]. The designers were probed on which activities were part of their designing to aid that users are able to access the functionalities products may offer, and how they checked whether the users really can and want to access these functionalities. The analysis reported in this paper focuses on the question how designers respond to the work situations in which they have to deal with meaning in product use.

A description of the participants is repeated in this paper, since it helps in placing the statements of the designers in context.
Six designers were from a large, internationally operating design agency. Three of these were product designers: one in medical equipment (TD), one in consumer electronics (FR), and one in consumer electronics and lighting (DS). One designer was a design manager in consumer electronics (JB). One was an interaction designer, also involved in designing consumer electronics (MR). And there was a product designer working both in user research and product design (MB).
Besides those from the large agency, another product designer was from a manufacturer of large office machines (GS). And another was from a smaller design agency with a large range of products, from packaging to industrial machines (SR). Two were independent designers. One of those two worked in the area of lifestyle products (CK), and the other in the area of utility products for houses (DSm). All are educated in the general domain of design, two in Germany (FR, SR) and eight in the Netherlands. Although the research was based in the Netherlands, the assumption can be made that the findings have some generalizability. Because of the international distribution of the products these designers were responsible for, many people in what is often termed 'the developed world' are likely to have used at least one product designed by one of these designers. Products discussed in the interviews included television sets, remote controls, domestic appliances, office copying equipment, juice packaging, MRI scan equipment, window blind systems, and domestic lighting.

Data analysis

The data were analysed with reference to the research question how designers respond to the work situations in which they have to deal with meaning in product use. The main focus in the inductive content analysis of this qualitative data was therefore, to discover themes in the data. "Findings emerge out of the data, through the analyst's interactions with the data" [13, p. 453]. All the interviews were transcribed and relevant video stills extracted. The data were coded for salient items of text or observation, and the coded items grouped into themes that are distinct from each other yet all relate to the central question of how the designers respond to the work situations in which they have to deal with meaning in product use.

In the presentation of the results, the choice has been made at this point to present each of the designers' quotes as individual quotes and not aggregate them into abstracted summary statements. This is to acknowledge the variation in their experience and arguments. Sometimes, their statements overlap, and sometimes, they contradict each other. However, it is also necessary to draw the findings from the individuals together into a pattern of interpretation. This is done at the beginning of each theme description. These descriptions are generalized in such a way that the description speaks of 'the designers', although there are differences between them.

3 RESULTS

The responses of the designers are presented here grouped in the themes that emerged from the analysis. Three main themes emerged: the perceived competence of designers, experience transfer and retention, and constraints on the design process. The last theme was a particularly salient one. In it,

several subthemes are identified and discussed as problems that could be addressed in the design process in order to enable designers to work in a more use-oriented way. Because the designers are not naïve in terms of the terminology they use, but professionally versed, it is possible to present the themes as much as possible in their own words. This is done in order to retain the contextuality of the data as much as possible within the written format.

3.1 Theme: what designers perceive as their competence and responsibility

"If I give you a rule, you'll come back to me within two minutes: and what about this? It's a matter of experience, in the end."

The designers take it on as their responsibility to make judgments about appropriate meaning. Although the marketing and research departments provide them with data, they have own ideas on users and user preferences, which they combine with the input they are given. Terms used by the designers to describe their competence in anticipating on product use: forecast, vision, design language, corporate design principles, intuitive, matter-of-fact, common sense, as clear as possible, not a specific point of attention, adapting formal rules to a product's particular configuration, making it better, using experience rather than rules, a certain feeling that a product gives you …

FR "There is a certain demand for consumer electronics products becoming more domestic. And then we try to combine this input with our own forecast, our vision. What the future would look like."
JB: "After an initial consumer test, it's up to the intuition and the talent of a designer to make a design out of it that really gets us somewhere. The consumer isn't going to tell you "do it like this". You use your own design language, combined with the corporate design principles in order to make something new. That's the added value of the designer."
SR "In the end, it's an intuitive process ... you don't really know how it comes about ... with all the information you have, you eventually reach a solution."
SR"(Instrumental meaning) is only a very small part of a whole development process, which has a lot of pressure on it ... and then, well, ergonomics or attribution of meaning, that's just ... it's such a matter-of-fact that it has to be done well, that it's not even a separate point of attention. Depending on the complexity of the product, of course."
DSm "I mean you design something and with your common sense you try to make it as clear as possible... and it's not like I would look at these problems specifically, explicitly."
Of the situation of the designer, CK says; "It's always easier to judge afterwards, why something succeeded ... beforehand, it's very difficult." He sees it as part of the competence of designers to bear this uncertainty and come up with something in this situation.
As DS says: "we wouldn't be designers if we couldn't adapt formal rules to each product's particular configuration." And in developing new concepts, SR states that: "That's one of the challenges of design - if a product has looked like that for twenty years, how do you convince the client (and the designers of the client) that it could be different? So we have to stir them up a bit and argue that if it could be better, you should make it better. And make proposals that show that clearly."
It also means that the designers think that general rules cannot be drawn up about product meaning. CK: "If I give you a rule, you'll come back to me within two minutes: and what about this? It's a matter of experience, in the end." "You cannot really make rules. You cannot pin it down. It's about experience, after all. You have to read a lot ..."
FR "There isn't a system for a product part to say "I'm a handle". I think we do that intuitively and as a designer you should do that intuitively. It's just a certain feeling a product gives you. If a surface is matte, for instance, it says "you can touch me". If it's high gloss, it says "don't touch me, I'll get a scratch".

What was striking about the designers' answers was that they hardly referred to any written recommendation material, neither abstract nor concrete, as sources of information. The only references that the designers gave were "you have to read a lot " (CK), and "the corporate design principles" (JB). So the designers seem to experience a lot of responsibility to be able to anticipate on product meaning in use from their professional experience.

But this assumed responsibility and competence of designers also has pitfalls. DSm: “sitting at the computer ... you’d be imagining how people will handle the product, how they will use it, how can they use it and how can you make that clear.” “Only recently something went wrong in that respect, with a remote control. The symbols on the buttons looked big enough in the drawing. But in the final product I had to put glasses on myself to be able to see them.”
The example gives an indication that a lack of even informal testing might be a pitfall for designers, because they assume that it is their task to be able to make these decisions. Yet they can overlook the contextuality of product use.

3.2 Experience Transfer and Retention

“I’m convinced that one builds the knowledge intuitively and takes it along to the next step.”

How do the designers acquire and call up this experience that enables them to anticipate on meaning in product use?
DSm “I always learn from previous projects. And it does get archived, more or less, so that another designer can pick it up and doesn’t make the same mistake.”
SR: “It’s an unconscious thing, you build your knowledge - for example by making a user manual, and you hear stories. It’s not like I write it down. I’m convinced that one builds the knowledge intuitively and takes it along to the next step.”
JB: “Experience helps a lot, because you don’t have to go through the entire learning curve. Normally we’d have had to build a little prototype and put weights in it and then you start all over again.”
FR: “It’s part of my job to know which materials are appropriate for this thing. I know it from experience in my design job, with input from colleagues and design fairs.”

At the large design consultancy, special ‘new ideas projects’ were run in order to develop basic knowledge and experience that the designers could then take with them into other projects. The ideas projects seemed to be experienced as effective by the designers (FR, MR) in generating shared ideas among the designers of what their state of thinking is about product use. While projects that are ca. ten years old tended to focus on associative physical form meaning (TD, DS), recent ‘new ideas’ projects had created shared ideas on the ways product behaviours can be meaningful for users. For example, anticipations on meaning revolved around the concepts of gestures and theatre (FR, MR, JB) (Figure 1). When MR explains the idea behind the design of a remote control, he does so by demonstrating the gestures himself that the user is expected to carry out with the product. In explaining the expected idea that the user will have about the virtual space being suggested by the interface, the designer makes a drawing of that virtual space idea and demonstrates how the virtual tip of the wand on the screen moves around that virtual space. The demonstrated gestures and the drawing and pointing at the drawing are themselves dynamic ways to indicate the expected use of the designed product. Where the designer has no words, he can use gestures and drawings. The background idea of gestures was more directly related to physical shapes. The background idea of theatre related more to atmospheres, whole environments.

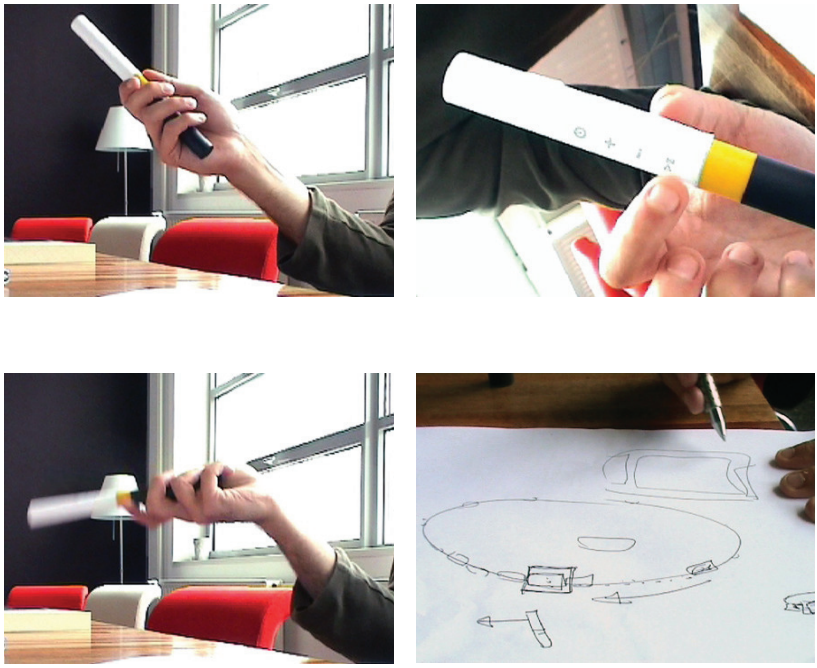

Figure 1: MR demonstrating and sketching the usage of the wand prototype for a remote control, a gesture-based interaction. In explaining the expected use, he waves the wand and demonstrates the various kind of gestures the user can make with it. He moves his pencil over his drawing in a simulation of how the image on the screen surface will suggest a spatial movement to the user.

3.3 Constraints to the design process

"So when we tested the prototypes, we already knew that they were too heavy."

The designers mention multiple constraints to the design process that limit their ability to think through anticipated use in depth. Designers are embedded in other processes - marketing, testing, trends, technology, corporate guidelines, interaction specialists, with which they negotiate and from which they take over information. And there is always, to varying degrees, time pressure and cost pressure. So even when testing is done it may not have any effect on improving the product.
JB: "So when we tested the prototypes, we already knew that they were too heavy. You'd be busy with something for such a long time, and know very well the dimensions and weight it should have. In the end design and ergonomics is about improving something bit by bit, against technological demands and shortage of money. We know the new product is too heavy and too long at the moment [because of the integrated lcd-screen], but we cannot solve it right now."

Another aspect is that the client is often not the end user and skews the priorities in the process, as SR mentions: SR "We get nearly all the information we use from the client. Of course they know a lot - their sales people talk to consumers a lot, so there's a lot of insight. On the other hand, a client has a lot on their agenda, not just product use. The end consumer may be a lot more interested in good handling and communication (of the product) than the client is."

In contrast to the constrained process experienced by most of the designers, independent CK was able to pursue his own ideas on meaning in product use. Products he designs are often self-initiated or part of a very open commission. “I have no frame within to work, unless I make it myself. I have no managers.” (CK). Interestingly, the products he had designed were the most engaged with use actions. Often the basic idea of a product derived from a use action or added a humorous twist to a use action.

For most of the designers interviewed, however, aspects other than product use often overshadowed the design process. To a large degree they constrained the outcomes of design. The full consideration of this finding is beyond the scope of this paper because it relates to managerial and organizational structures in which design is embedded. In the following, some themes are presented that relate to the constraints and which can be addressed within the domain of design. They are presented in such a way that their present limitations, as perceived and experienced by the designers, are emphasized. The conclusions section will discuss how these aspects, particularly, could become avenues for better integration of product use in designing.

The distance to ‘proper’ testing

All but one of the designers (MB) in this study were seldom closely involved in a formal usability test or user research. Formal usability research is done by other contractors of the client for the independent designers (except CK, see below), and by internal experts for the designers from the design agencies. The exception who is involved in user research, MB, has a combined role of user researcher and designer, which she can leverage in communication between the fields. At the large design agency, testing is well-instituted at various steps in the design process. However, as we saw above (JB), it often comes too late or exposes problems that are already known but cannot be alleviated. For the independent designer of utility products (Dsm) and the designer at the small design agency (SR), testing often falls prey to time and money. Doing testing is also hampered with certain target groups such as children - “You have to have a product in a pretty advanced stage before you want to try it out with children” (TD) and there are problems of confidentiality. Still, in the large design agency it would be quite possible for designers to involve non-designers in tests without running into confidentiality problems. But this choice is not always made, especially with ‘new ideas’ products, which do not yet have to answer to the normal standards of the market and usability. “We never did it here ... I think it’s nice to be just with designers and to think the story through before you’re going to test it (FR).

Limitations of consumer feedback

Such insights are mainly available for products that are well-established as a category. The case in point is remote controls. JB: “If you look at one that was sold ten years ago, then all these buttons are blank from long term use. We know that because we also sell replacement controls, and then you get the old ones back. Besides that, I often stay in hotels and there you see TVs that are being used every day. Well on every second remote control the channel up-down and the volume buttons have no print on them anymore. Yet people are still able to use them, blindly” (Figure 2).

Figure 2: JB demonstrating which buttons on a remote control are used by most people in the same way. JB means here the button group he is indicating with his index finger. At the same time, he is demonstrating a hand grip that may look unusual to some remote control users.

Improving on problems in use in designed products is a matter of "incremental improvements" (DS). This is not the stuff of really interesting design work, but a gradual improving of usability of a product that is already in the market, based on feedback from the field.

Unrecognised informal testing

While most of the designers experience some distance to formal usability testing, most of them mention informal ways of testing that they conduct themselves: with colleagues inside the company, or themselves and with their family. They only tended to tell the interviewer about this after a bit of probing. They do not think of it specifically as testing or as usability testing, but rather as an integral part of their design practice.

DSm "We make a test set-up in the client company, and we let people from the client company play with it. And then of course, you get a round of presentations to buyers, you also get feedback from that. I'm quite happy to let the specialists who are very familiar with the product play with it. At least they know what to pay attention to." "Well and beyond that, I've still got my family ... I'll install one of those things at home, and then I test it. You bet I get feedback from that!"

SR "We always work in teams, never alone. First we discuss things internally and everyone has a different opinion - and that's how you get a kind of discussion going." "In one case the client didn't have much money, but it was a product requiring a lot of testing - I solved that internally here. With the first full size prototypes of course I asked people from in our office to try and assemble it. At one point everybody inside the company had had a go at it - but you need someone who hasn't done it before - well then I asked my mother to assemble it and even she managed to do it."

FR "Of course, with 25 designers working on the project there was a lot of interaction. We always make lots of samples, try out a lot, make decisions together. We try the prototypes, touch them, evaluate them. It's always like that in design I think, you want to get some feedback. Do others like it or is it just me. It's also related to aesthetics. Do I like to touch this surface?"

FR "Yeah and you'd ask your girlfriend at home, do you like it or not like it? But in general I think it's part of my job to decide what's appropriate or not appropriate for this thing."

CK “I don’t really do testing.” (But:) “I make prototypes for myself, in order to see what I’m doing.” “If you’ve been busy developing something for two months, you cannot judge anymore whether anyone is going to understand it and then you need other people.” “It is like a kind of language, after all. If I write something down and I ask: do YOU understand it? Does HE understand it? Why not? Is he right not to? But if I write it down like this, and he does understand it ... you do want to communicate, after all.”

These informal testing activities seemed surprisingly well-established with the designers. While for independent CK they are a mainstay of his development process, for the other designers these activities seemed less well integrated with the rest of their process, and sometimes they left them out with adverse consequences as seen above (3.1, Dsm).

The list of user requirements

A list of user requirements also has the role of being available throughout the process, and to bring questions of product use back into the process. However, it seems to merely serve as a checklist of features, rather than as an integrated look at product use.

SR “Then one might look back at the list of requirements and you see there needs to be a button there. Of course you have it at the back of your mind all the time, but it is sometimes remote, and then it becomes central again. It comes and goes. It’s not like we say at one point here’s a nice shape now, so where do we put the button.”
JB: “The user requirements have a number of aspects. One of those is an interaction guideline. It describes ‘what happens when you do this’ and ‘what happens when you do that’. The interaction guideline also has a translation to a product structure, and a product layout. So that is what we have for remote controls.”

Compiling a user manual – at the end

Making a manual seems to have an unintended side effect for some designers of really thinking through product usage for the first time. DSm “I also make user manuals and then you see, while you’re at it, you’re really analysing how the (finished) product works and whether everyone will understand it, and then you see that you have to explain some aspects more clearly.”
SR “I do think that ... unconsciously you get a lot of insight (on product use) by making a user manual.”

When this is done post-hoc, it can bring somewhat painful insights to a designer. DSm: “then you see that you have to explain some things ... there was so much pressure on finishing the product.”

However, the manual is not always in the hands of the designers. SR: “There are consumer products that are so complicated that it will surely go wrong for users. And that means that one has to develop a whole user manual. If one gets the chance to do it. Often, manufacturers themselves do the manual and that’s not a desirable situation.”

4 CONCLUSIONS AND OUTLOOK

The responsibility that the designers feel for product usage as their competence, seems like a good thing on the one hand. However, the research also showed that they are not always certain of what to do and that mistakes can happen when they feel pressured to make decisions. In relation to this observation, it might be useful to develop ways for the designers of thinking about ownership of the design. The designers could be offered a way of looking at the design as theirs in one moment, and as the users’ in another moment. Perhaps in a playful way, to ‘choreograph’ the consideration of when the designer is ‘owner’ of the product, and when the user is ‘owner’ of the product and what this means for the behaviour of each.

Some surprising testing techniques emerged through this research, for example the use of the user manual as a design tool, as an interaction story to be imagined. Rather than a naïve “this is how to use it”, the user manual seems to serve as an inadvertent reflection by the designers on how their product

will actually present itself and respond in product use. However, the manual is usually done at the end of the process. Of course, techniques such as scenario-based design have similarities to a user manual before the fact. They in turn can be ineffective when they are not realistic enough. So an interesting problem for future research is how to bring the realism of a user manual into an advance scenario of product use.

Another potentially consequential insight is the designers' informal use of usage testing and the fact that it is 'hidden away' by the designers in their design process. In usability research, it is often considered undesirable to have designers too closely involved in the testing. The idea is that they might inadvertently try to influence the test or explain to users what they have to do. And it takes special training to conduct proper testing. But the flipside of this can be that designers experience a distance from the testing process. Most do some form of informal testing for themselves, it was found here. A risk in this is that they do not do this in a sufficiently contextualised way to get appropriate information on meaning in product use. They may only take themselves as the model user. Risks of this have been described many times in the participatory design and inclusive design literature. Yet the fact that the designers feel the need to do this testing themselves, can be a valuable point of departure for specialists on testing and usage to work with, rather than just for designers.

Of course, time pressure often demands compromises in a design process. Since there is no explicit moment or place to consider meaning in product use, it is sometimes rushed through or crowded out. In order to give the informal testing activities of designers more value and also make them more suited to their design task in some cases, it might be useful to talk more explicitly and evocatively in design about the role of the prototype. Prototypes can be made contextual, one can interact with them. Most designers make some kinds of prototypes during most of their design processes, especially when the result is particularly new and not just an upgrade of a previous design. Suchman [15] and Zimmerman, Forlizzi and Evenson [16] provide useful thoughts on the role of the prototype/artifact in design, stating that it can be a catalyst for decision making and communication. Methods and techniques could be developed to give prototypes a more prominent role in exploring user activities, to connect them to informal but contextual testing activities. In order to specifically be useful for the experience of product use in designing, they should also become connected to more explicit discussions of what kind of scenario or 'user manual' might be connected to them.

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Contact: S.U. Boess
Delft University of Technology
Faculty of Industrial Design Engineering
Landbergstraat 15
2628CE Delft
The Netherlands
+31 15 278 3196
s.u.boess@tudelft.nl
http://tinyurl.com/26fasx

Stella Boess is an assistant professor of design for interaction at Delft University of Technology. She received her PhD in design research from Staffordshire University (UK) in 2003, on doing user research as a designer. Degree in product design from the HBK Saar (Germany) in 1994. Experience includes product design consultancy, independent concept work and usage research for design.