

# From Perception to Experience, from Affordances to Irresistibles

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## ABSTRACT

In this paper we report on how we grew in design research. We begin with the first author's discoveries on 3D imaging on a flat screen, and we end with the second author's latest endeavours on creating meaningful couplings between action and function. In the mean time we sketch what we gained between these two landmarks. We think wise lessons were learned on this long and winding road, and we want to share them with you. Meaning emerges in action. Therefore information for action is a crucial issue for interaction design. We conclude with offering our current views on design research within a university context.

**Categories & Subject Descriptors:** Design Tools and Techniques *User interfaces*

**General Terms:** Design

**Keywords:** Interaction design, design theory, affordance

## INTRODUCTION

We want to tell you a personal story, the story of an old dog, the psychologist, and the complimentary younger one, the designer. Over the last 20 years the psychologist struggled with research in design. The last quarter of this period the young dog (and others) kept insisting on a more designerly approach to design research. What about a design theory? What about research through design? This was not an easy road, but an interesting one, to say the least. This paper sketches the design research road we followed, and presents the conclusions we came to. We offer them to you reader, now it's your turn to do something with it, or not, as the case may be.

## THE PSYCHOLOGIST'S JOURNEY

To get rid of its 'arty' reputation, some designers moved to the university, and to technical environments. The reasoning was that, once the designer would become an

engineer-designer, other engineers would take him seriously. And 'the others' would finally understand that design is not just about styling, but a way of looking at the world and reshaping it, a way of generating knowledge through creation.

Within this context the psychologist entered the university to do research in design, together with Michael Stratmann a fully-fledged designer (the young dog wasn't into design yet). And what do perception psychologists study when they do design research: perception? We turned to the theory of direct perception though, because we saw it as having relevance for designers. What is this theory about? Gibson [6] attacked the traditional reconstructionist or cognitivist stance on several points. First, the eye is not just hit by light, but by structured light. The *Ganzfeld* experiments had shown that unstructured light as such does not result in perception. It just results in the impression of being in the fog. Gibson holds that our perceptual system (note he does not say the eye) is sensitive to the three-dimensional structure of light, to patterns. Second, perception is not an automatic brain process mediated by inferring and memory. It is an active sampling of the structured ambient light. Why active? Because the world unfolds itself in possibilities for action. The world affords actions to an organism on the scale of that organism. And so we get to the third essential point of his theory: the world appears to us as inherently meaningful because we perceive action possibilities, i.e., affordances. Meaning is in the world, directly, not inferred through reasoning.

Let me explain this with an example. When we look at the floor we can discern texture. Close by this texture is coarse, further away fine. There is a one-to-one relationship between one's standpoint and the way the texture of the floor structures the light in gradients. When one moves, the gradient changes in a systematic way. These systematic shifts inform me immediately (i.e., without mediation) about the layout of the room. The floor affords walk-ability to me. A bench affords sit-ability when I'm tired. Meaning is thus in our relating to the world.

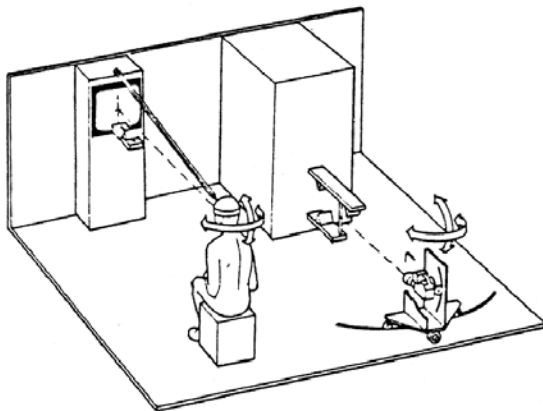
What are the consequences of this theory for design? Designers make objects and want them to mean something to the user. They, at least we may reasonably assume this, strive for natural or intuitive man-product interaction. And

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Gibson's theory seems to lend a helping hand here. His theory is about meaning in interaction with the natural environment, and thus, by extension, with the world of artefacts. The designer thus has to start by examining the user's perceptual-motor skills, we then reasoned. From this analysis, i.e., what a user normally does, he can deduce how a product should work.

So, let's talk action. In 1988 the psychologist, together with Michael Stratmann, defended his PhD entitled *Depth through Movement*. Central to this thesis was the question: "What do people need to get a 3D impression?". Standpoint and change of standpoint reveals a lot about spatial layout as we stated above. Imagine someone looking at a scene depicted on a screen. If we now measure the viewer's head movements, and feed through the image corresponding with every single point of view, the viewer gets a 3D impression of the scene [13].



**Figure 1** The person looks at a flat screen and, as she moves, the camera follows her movements. The wedge system, recorded by the camera, is depicted on the screen. The person has the impression to look at a 3D scene and is even able to align the upper protruding virtual wedge with the lower wedge placed in front of the screen.

No stereoscopy is involved. Movement parallax suffices (see Figure 1). This resulted in the Virtual Window System (DVWS) that has been applied in Cambridge Xerox EuroParc [4,5].

Tom Djajadiningrat, who by then had joined the team, developed this system further in a desktop Virtual Reality system for his PhD [2,3]. Cubby is a desktop VR system with three orthogonal screens forming a cubic space of 200x200x200mm. Through the use of movement parallax on all three screens, a virtual object is created that stands within the cubic space. As the virtual objects appear in front of the screens, Cubby makes it possible to unify the display and manipulation space. A hybrid instrument (partly real, partly virtual) allows for accurate manipulation, as the virtual tip is rendered with the virtual scene (see Figure 2). By simply tapping into the natural body movements we were able to create virtual interaction.



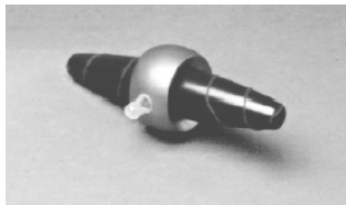
**Figure 2** The head movements of the person are recorded. A computer generates 3 images, corresponding with the person's viewpoint, and projects them on 3 orthogonal screens (left). The person sees a 3D object and has a hybrid instrument with which he can interact with this object (right).

It goes without saying that all these systems have been empirically tested in experiments.

Don Norman had by then embraced the concept of affordance too. As he gained more and more influence in the field of design by way of his excellent books, affordance became a buzzword in the design community [8]. But there is something lacking. Norman's books contain plenty of examples of bad designs, but very few of good designs. As Hummels [7, p.1.21-1.22], who by then joined our team, puts it: "Unfortunately, Norman and many other researchers have (...) interpreted the concept of affordances narrowly. They relate it only to the perceptual-motor skills of the user and the characteristics of the environment, but they leave the intention and the feelings of the user outside the basic concept. In practice, the concept has become even narrower. An affordance is often considered simply as a physical characteristic of the environment [11]. We share Sanders' opinion that Gibson's brilliance was the unity of subject and object, which naturally includes one's intentions and every action an organism is able to perform, including imagination [10]".

We deliberately moved from 'cold' affordances to irresistible ones. An example from second-year design students makes this clear. The students mainly focus on the richness of the senses. The three containers depicted were specially designed for Ice Coffee, Ginger Ale and Dr. Pepper soft drinks. The Ice Coffee package elicits firmness and strength with its dark colours, the two handles and the small opening to slow down the drinking speed. The Ginger Ale container reflects freshness and sharpness through the taut silver coloured funnel and the small compressible capsules, which prohibit the consumption of large amounts of liquid. Finally, Dr. Pepper is bottled in a cheerful, exuberant reddish bulgy shape with flexible straws to attain a playful, sweet and exciting drinking experience. So, people are not invited to drink only because a design fits their physical measurements. They can also be attracted to act, even irresistibly so, through the expectation of beauty of interaction. Temptation could be the goal. So, quite a long time ago we made the point that product functionality as such does not suffice [12, 14]. If affordances are about meaning, they are not just about functional meaning; they do not only fit our perceptual-

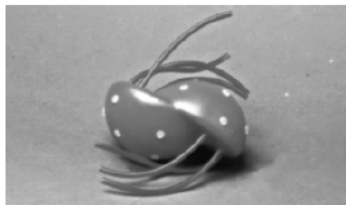
motor skills, but also our emotional and cognitive skills. Man as a whole should be respectfully embraced.



Ice Coffee package



Ginger Ale package



Dr. Pepper package

**Figure 3 Three drink containers**

This left us with a heap of concepts, which were apparently difficult to reconcile. To name just a few: perception, perceptual-motor skills, emotion, rich interaction, beauty interaction, the wholly trinity of interaction, design, research through design, respect, experience, intuition, common sense... We published a ten points sloganesque pamphlet emphasizing our (lack of) coherence of views on these matters [1]. We stated that the user is in search of a positive experience. Therefore the designer needs to create a context for experience, rather than merely a product. She offers the user a context in which he may enjoy a film, dinner, cleaning, playing, working ... with all his senses. It is her task to make the product's function accessible to the user whilst allowing for interaction with the product in a beautiful way. Aesthetics of interaction is his goal. The user should experience the access to the product's function as aesthetically pleasing as possible. A prerequisite for this is that the user should at the very least not be frustrated. However, we are not promoting "ease of use" as a design goal. Interfaces should be surprising, seductive, smart, rewarding, tempting, even moody, and thereby exhilarating to use. The interaction with the product should contribute to the overall pleasure found in the function of the product itself.

#### **THE DESIGNER'S JOURNEY**

Yes, but how can a designer materialize these theoretical insights? Here is where the young dog comes in. His

research project illustrates how far we are now. He proposes a method for designing adaptive products on the basis of emotionally rich interactions. By emotionally rich interaction he understands interaction that heavily relies on emotion expressed through behaviour. The essence of this approach is that a product not only elicits emotionally expressive actions, but that the feedback is inextricably linked to these actions. The mood (emotional skills) is read by the alarm clock (Figure 4) from the way the user interacts with the machine (perceptual-motor skills) while feeding it information (cognitive skills), i.e., the wake-up time.

The young dog reported extensively on his research elsewhere [15,16].

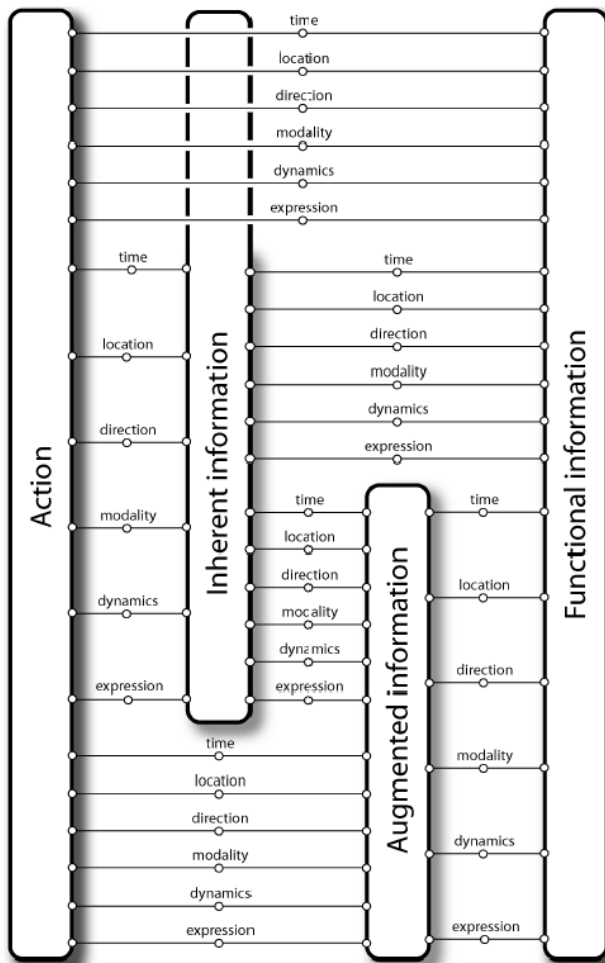


**Figure. 4 The working prototype. The user can set the time by sliding the knobs towards the central alarm display. And he can do this in many different ways, eliciting him to express his mood.**

The question that concerns us here is the impact of his research for design. In 2001 Paul Dourish published his book *Where the action is* [4]. He makes an analysis of interaction design and concludes, on the basis of philosophical and experimental arguments, that the coupling between people's action and the product's function creates meaning. We knew that much, but on the basis of what meaning creation should the coupling of action and function be realized? The young dog offers us two important ideas as a result of his research: first, what is the nature of the coupling, and, second, the aesthetics of the coupling.

The first idea is "bridging". The user needs information to guide his actions towards the intended functionality. How can action and function be coupled to generate this information? A mechanical product allows for freedom of interaction and here the user's action and the product's function are naturally coupled. What is natural? He identifies six aspects of action and function, i.e., time, location, direction, modality, dynamics and expression.

When action and function are unified on and every one of these aspects, they appear naturally coupled. In contrast, in electronic products action and function often are not unified on these aspects. Whilst this brings many advantages for new functionality (e.g., remote control, programming) it often results in non-natural interaction. To restore natural interaction in electronic products the user needs information to guide his actions towards the intended function. Therefore Wensveen focuses on the creation of information through feedback and feedforward.



**Figure 5** A framework for the different coupling possibilities between the user's action and functional information. The inherent information and augmented information can be used as 'bridges' when direct couplings on the six aspects cannot be established.

These different types of information are the elements that can bridge action and function together by realizing couplings on the six aspects. Figure 5 gives a framework for these different coupling possibilities. This framework aims to enrich both the action possibilities and the related inherent feedback and feedforward to allow for richer couplings between action and function.

In many current electronic products the bridges between action and function are realized through the use of augmented information, which results in LCD displays and the lexical labelling of action possibilities. Guiding the user's action towards the intended function therefore, puts a lot of effort on the user's cognitive skills. Another observation of current electronic products is that, while the product functionality does offer differentiations on most of the six aspects, the bridges between action and function are realized mostly through the unification of just two of the six aspects, i.e. time and location [Norman's concept of 'mapping'], which results in the use of appropriately placed buttons. Still other interaction styles focus on 'natural interaction' by making use of gestural and speech interfaces. They exploit the cognitive and perceptual motor skills of a person. Although rich in action possibilities these interfaces lack inherent feedback and feedforward and completely rely on a tight coupling between action and function on the aspect of time, or on couplings through augmented feedforward. Graphical User Interfaces (GUI) are poor in action possibilities and resort to the enrichment of augmented feedback and feedforward to restore the couplings between action and function.

In contrast to these different interaction styles Wensveen argues for the following tangible approach: Through a combination of enriching the action possibilities which exploit the human repertoire of actions and the inherent feedback based in the richness of the physical world the quality and number of possible meaningful couplings between action and function are increased.

An example of how this approach can investigate the role of tangibility is the comparison two versions of the Apple iPod. There are two versions of the Apple iPod where one has a mechanical scroll wheel and the other a touch sensitive scroll 'wheel'. This makes that the two versions differ in dynamics (the force of rotating versus rubbing) as well as in modality of the action and the inherent feedback, where the mechanical version is richer in modality. The mechanical scroll wheel also allows for a dynamic trace since the wheel continues to rotate, be it for a short while, even when the user's action has ceased<sup>1</sup>.

The framework invites and challenges designers and researchers for the exploration of couplings. The decision of how to couple action and function is for the designer to take, not for the framework.

What about the aesthetics of couplings, the second idea offered? Wensveen had subjects set the alarm clock after they were induced to one of eight moods. By looking how the end patterns came dynamically about, he set out to predict what mood they belonged to (Wensveen et al.

<sup>1</sup> An experiment can test if these differences. This means that the framework can not only be used for design practice but also for research because it provides an operationalization of 'natural interaction'.

2002). He noticed that classical aesthetic patterns like balanced and symmetrical ones were the most predictive ones. He thus found a strong indication for the aesthetics of interaction.

### **CONCLUSION: GETTING THE DOGS TOGETHER**

What is design doing at a university? In other words, is there something like a design science? And, if yes, how does it relate to practice?

We do not know the answer to these questions. We do know that many attempts have been made to ground design firmly in ideology, phenomenology, aesthetics, (perception) psychology, sociology or all of them together.

What we can offer you is our story and our beliefs, and a hopeful path for the future. Therefore, at the end this paper, we offer you these theses in a rather sloganistic form

1. Design is about people in the first place. It is about our lives, our hopes and dreams, our loneliness and joy, our sense of beauty and justice, about the social and the good. It is about emotion.
2. There is a primacy of action. In accordance with Dourish's and other's approaches to epistemology, we strongly believe that meaning cannot be detached from action. Meaning is in (inter)action.
3. A design theory consequently must be a theory of action in the first place and of meaning in the second, and not the other way round. Reflection on action (of designers and users) is the source for knowledge.
4. The accompanying methods must be rooted in design practice, invigorated by experimental methods from other disciplines. Research through design.
5. Intuition and common sense should be high on the agenda. They should be exploited to the maximum.
6. This means that designers, trained in research, should take the lead. Design research is essentially a multi-disciplinary effort, but led by designers.
7. As a practical consequence, when moving from art school to a university, designers should get trained in research and PhD-ed as soon as possible, and become the full professors.
8. Design schools at universities are about making rich technology accessible through rich concepts, but, again, starting with the concepts.
9. Researchers from other disciplines are subsidiary. The danger is too great that they will not be able to leave the cocoon of their own discipline, as many stories teach us.
10. Finally, we should realize that design practice and research are a powerful generator of knowledge. It

is a way of looking at the world and transforming it. Just as classical sciences are

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