Paper for the the Sixth Nordcode Seminar & Workshop, Design Semiotics in Use, June 6-8, 2007 at the University of Art and Design Helsinki in Finland.

# Meaning through doing: The role of affordances over time

Kyle Kilbourn / *kyle@mci.sdu.dk*

Mads Clausen Institute for Product Innovation
University of Southern Denmark
Sønderborg, Denmark

Jessica Isaksson / *jessica.isaksson@chalmers.se*

Department of Product and Production Development
Chalmers University of Technology
Göteborg, Sweden

*In Gibson's theory of perception, an organism directly perceives the value of the environment through affordances. By affordance, Gibson means the opportunities or possibilities of nature, which require the act of information pickup. Within design theory, however, there is a strong tendency towards separating perceptual information of affordances and the affordance itself. Combining theoretical discussion with an empirical case study of a medical device, we suggest there is untapped value in the notion of direct perception and argue that there is meaning through doing. Looking at the role of affordances over time, instead of a person's first exposure to a product necessitates sensitivity toward enskilment and how people create meaning through the use of products.*

**Keywords:** *affordances, enskilment, haptics, meaning, perception, skill*

## INTRODUCTION

The visual qualities of products have been the focus of much theoretical discussions and development work in design. The belief about and trust in the complete dominance of our visual perception has often resulted in simplifying the way people can physically interact with products to just pointing and clicking (whether with a mouse, stylus or finger) while more sophisticated ways of visually identifying possible ways of interacting with a product proliferated. However, the limiting of the interactions to achieve ease of use will not create rich meaning in using the product. We argue that meaning derives

from interaction over time. Products with almost identical interaction capabilities do not allow for recognition of the experience and the resources inherent in how we use our bodies. The purpose of this paper is to reflect upon how perception changes and show the importance of the physicality of products to meaning over time through theoretical discussion on affordances and analysis of an empirical study of a medical device.

## GIBSON'S WORK ON AFFORDANCES AND HAPTICS

In his efforts to form an ecological psychology perspective[1], Gibson (1979) developed direct perception or how an organism directly perceives its environment without cognitive processing. Central to his argument was the concept of affordance which has been appropriated into design research, hence our focus specifically on Gibsonian thinking. Gibson understood affordances as a relational potential for action between the organism and its environment: "The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill" (1979, p. 127). With this, Gibson suggested an alternative theory about objects in that we do not perceive qualities, but rather affordances:

> Perhaps the composition and layout of surfaces constitutes what they afford. If so, to perceive them is to perceive what they afford. This is a radical hypothesis, for it implies that the "values" and "meanings" of things in the environment can be directly perceived. Moreover, it would explain the sense in which values and meanings are external to the perceiver.
>
> **Gibson, 1979, p. 127**

> The meaning is observed before the substance and surface, the color and form, are seen as such.
>
> **ibid, p. 134**

However, Gibson (ibid, p. 33-4) does not further explain how meaning is formed beyond just the fact that meaning can be discovered based on what an object affords, for example a partial enclosure is often a shelter. Because of the need to discover meaning, Gibson suggests that we "probably see better when moving than when stationary" and pursues the idea of perceiving while moving (ibid, p. 197). As Zaff (1995, p. 241-2) observes, we perceive ourselves in relation to the environment but may fail to detect an affordance because of a lack of attunement. Gibson (1979, p. 254) refers to the "education of attention" as a way to improve perception.

We argue that it is fruitful to return to Gibson's direct perception, while also extending his idea of what it means for an affordance to have meaning. This requires conceptualizing beyond just visual perception and incorporating haptic perception. In his earlier work, Gibson (1966, p. 123) provides an indication of how this is possible: "Active exploratory touch permits both the grasping of an object and a grasp of its meaning" . He continues:

> We are not accustomed to think of the hand as a sense organ since most of our day-to-day manipulation is performatory, not exploratory. …The perceptual capacity of the hand goes unrecognized because we usually attend to its motor capacity, and also because the visual input dominates the haptic in awareness
>
> **ibid, p. 123**

In 1950, the psychologist Révész termed "haptic" to refer to impressions conveyed by the kinematic and tactile senses (Carterette and Friedman, 1978). The kinematic sense can be described by the term kinesthetic: the feeling of movements in limbs, relating to sensations in muscles, tendons and joints. The tactile sense relates to the skin as a sense organ, including sensations of pressure, temperature and pain. In contrast, Gibson (1966, p. 49-50) thought of the senses, like to hear, as passive abilities and instead

1 The term "ecological" traces its roots to ecological biology rather than the alternative use of the term to mean sustainability. Ecological psychology concerns itself with the relationship between organisms (people AND animals) and the co-evolution with the environment and our use of the terms should be interpreted in this tradition.

referred to active perceptual systems. The haptic perceptual system involves nearly the whole body, unlike the other systems (visual, auditory, taste-smell) which use separate organs like the eyes, ears, mouth and nose in order to perceive, (ibid, p. 50). Within the haptic system, we can think of the hand as an executive organ, which both perceives and takes action. One can grasp, grope, feel, push, press, rub or weigh and thus discover many object qualities. Later in this paper we return to exploratory movements and how they change to performatory movements over time, but first we discuss how these concepts have been used within design.

## DESIGN'S USE OF AFFORDANCE

In everyday situations, a person's first understanding of an object is based on visual perception. First we observe an object, then we choose whether or not we would like to and how to lay our hands on it. When people see a tool, Révész (1950) maintains that brain processes related to their haptic sense and the possible upcoming haptic interactions activates immediately. Take the example of how to grab a newly encountered door handle. The first visual impression tells us it is a handle which can open the door to allow passage. This is perhaps followed by an anticipation of how to grasp the handle. But this does not always tell us how the handle can be manipulated regarding the amount of force, when to pull or even the amount of rotation required. That will require haptic exploration or some kind of visual guidance.

Product semantics has been defined by Krippendorff and Butter (1984) as:

> …the study of the symbolic qualities of manmade forms in the cognitive and social context of their use and application of knowledge gained to objects of industrial design.

This means that product semantics suggests a relationship between the user, designer and the product with the importance that artifacts assume in an operational and social setting. The focus is on the artifact and the designer, not the relation between the user and the product. In the application of semantics the suggestion would have been to create guidance to explain how the door handle should be manipulated, for example an arrow, symbol, or a text label; information that needs cognitive interpretation to be understood. To avoid this reading and interpretation, we suggest another look at Gibson's (1979) work of direct perception, which do not require mediation or internal processing by the user. With the example of the door handle it should afford the user to perform the correct action through haptic manipulation, i.e., by its shape.

A more complex interface often requires several actions in a row to complete a task, called nested affordances by Gaver (1991) and McGrenere and Ho (2000). The nested affordances can consist of both visual and haptic exploration. With the door handle example, the visual exploration indicates grasping, while how to turn the handle is indicated by haptic exploration. This is called sequential affordances, one affordance leads to another (Gaver, 1991). We return to nested and sequential affordances towards the end to the paper.

With Norman's introduction of affordance to design in the "Psychology of everyday things" (1988), a distinction was made between real and perceived affordances. McGrenere and Ho (2000) in trying to clear up the concept of affordance refer to Norman saying "It's very important to distinguish real from perceived affordances. Design is about both, but the perceived affordances are what determine usability." Design, however, has latched onto perceived affordances and reduced it to mean information, resulting in a focus on how to make this information usable. Gaver (1991) extends this line of thinking by producing a framework that splits the perceptual information from affordance. This analytical move produces the unfortunate result of a false affordance where there is perceptual information but no actual affordance, as problematized by McGrenere and Ho (2000). In spite of this, You and Chen (2006) expand upon Gaver's framework of separating affordance from information by adding a third dimension of the presence of a symbol or not.

We see this as inconsistent with an ecological perspective of direct perception. We argue that these moves

require a loss of the notion of skill and learning in perception and action. By creating products that rely on symbols to give the message of use, you create the situation where the fix for any and all problems is to put an icon or phrase describing the actions possible. This change from direct perceptional to cognitive interpretation can paradoxically make learning more difficult. The challenge for designers should be in creating products where exploration is encouraged until skilled performance is possible. We see that in design the concept of affordance has taken on multiple roles and continues to diverge from the ecological perspective advocated by Gibson. To suggest an alternative possibility, we introduce a short empirical case within healthcare, in which users snap a bottle into place as a part of dialysis.

## CASE OF THE BOTTLE OF CONCENTRATE

As part of the opportunity to have dialysis treatments at home, patients train to setup the hemodialysis machine. These patients are dependent on the machine to cleanse their blood several times a week. Having the treatment at home allows them the flexibility that doing it in the hospital does not provide. To understand how patients learn to do self-care, we followed a patient in the first week of training with nurses in the home dialysis unit. The training is staggered in that the patients train to setup the machine and then move on to take on additional tasks in the dialysis process including self-insertation of needles, eventually completing the entire process themselves. To facilitate better analysis of the use details, the sessions were recorded on video.

**Figure 1:** Placing the bottle of concentrate. From left to right, the nurse showing the patient how to place the bottle on the first day. On sequential days, the patient struggles to place the bottle.

On the first day of training the nurses complete the setup of the machine by inserting all of the necessary supplies of tubes, concentrates, filter, etc. We focus on a small part of the process, the placing of the bottle of concentrate near the bottom of the machine (Figure 1). The patient watches the nurse as she shows and tells about each step. In this case, the first mode of attention (using Gibson's term) for the patient involves essentially the visual perceptual system, as well as the aural system. He can scan with his eyes and head while seeking better positions to see the action of the nurse through locomotion. The patient perceives through visual exploration mainly, but he also receives auditory feedback from the nurse. The visual information starts to activate brain processes related to the haptic sense and possible haptic interactions. The only understanding of use that can be attached to the bottle of concentrate is it's positioning in the process and the clicks it makes. However, Rizzo (2006) offers evidence that designers should be aware of intentional affordances or how people can explore visually through other's haptic exploration. We do believe there is an element of haptic exploration that is possible, but classify this as visual exploration.

On the second and sequential days, the patient sets up the machine with guidance from the observing nurse. The nurse intervenes only when necessary, allowing the patient to get hands-on exploration. This allows for the second mode of attention or the haptic perceptual system to explore the machine. While learning does occur with the visual perceptual system, it is in combination with the haptic system that the patient truly learns to use and setup the machine. This is not without problems. In days two and three, he struggles in placing the clip that snaps the bottle in place. The nurse helps by lifting the clip up and trying again to snap it down.

By the fifth day, the patient manages to place the bottle of concentrate correctly. He is not as fluent in his actions as the nurse yet, but is moving from exploration to skilled performance. Before becoming skilled, he learns how to work with the product affordances. But he also develops an additional meaning of the bottle, besides just a step in the setup process, through using the machine. During the dialysis, the machine often alarms to draw attention to possible errors. A frequent occurrence is the conductivity alarm. In dealing with this type of error, the nurse spins the bottle of concentrate around to loosen it up a bit. Eventually the patient understands this as a way to deal with the conductivity alarm and spins it himself by day three. Now it is the nurse who mimics the patient and spins it again. The meaning of the use of the bottle has developed over time.

## PERCEPTION OVER TIME

When looking at perception over time, there needs to be some mechanism to account for learning. While some may go for a complex memory storage system, from an ecological approach the alternative is to rely on a complex learning process (Rubin, 1988). Gibson advocates for learning as well:

> The inputs of a special sense constitute a repertory of innate sensations, whereas the achievements of a perceptual system are susceptible to maturation and learning. […] The information that is picked up, on the other hand, becomes more and more subtle, elaborate, and precise with practice. One can keep on learning to perceive as long as life goes on.
>
> **Gibson 1979, p. 245**

In the case of the bottle of concentrate, the patient learned to perceive the bottle in multiple ways because of the events in which he participated with and used the bottle. As perception is intimately linked with action, perceptual learning can become a part of a practice of learning to perceive. Lave and Wenger characterize the relationship between learning and practice: "Learning itself is an improvised practice: A learning curriculum unfolds in opportunities for engagement in practice" (1991, p. 93). While it may seem unusual to educate the attention of the visual perceptual system, we suggest taking a look at many of the examples in the edited volume *Skilled Visions* (Grasseni, 2006) including cattle ranchers and drag queens and how they learn to perceive within their particular context. A rich area for further research could be the ways designers are educated to see skillfully.

So how does one get around the problem of conceptualizing a process instead of a structure? Ingold (2001, p. 27) offers a suggestion by saying: "These skills, then, far from being added on to a preformed body, actually grow with it. In that regard they are fully part and parcel of the human organism, of its neurology, musculature, even anatomy, and so are as much biological as cultural." Thinking of process as growing allows one to weave it with the structure of the body.

Instead of building upon Gaver's separation of information and affordance, we suggest that designers instead work with Gaver's other insight, namely of grouped affordances. Gaver (1991, p. 82) distinguishes between two types: "Sequential affordances explain how affordances can be revealed over time; nested affordances describe affordances that are grouped in space." In our view of affordances over time, the initial mode of attention (usually the visual system) elicits the help of other modes (like the haptic system) for exploration. This forms exploratory perception that after a period of learning (education of attention) changes to performatory perception as a skilled performance. Both instances of perception are direct, but meaning develops over this period. Taking a cue from Ingold (2006, p. 67) talking about the process of walking, he says "Their [steps] order is processional rather than successional. In walking, every step is a development of the one before and a preparation for the one following." So while Gaver was right to think of affordances revealed over time (sequential affordances), it might be more accurate to think of them as processional affordances and incorporate anticipation and preparation for the next step.

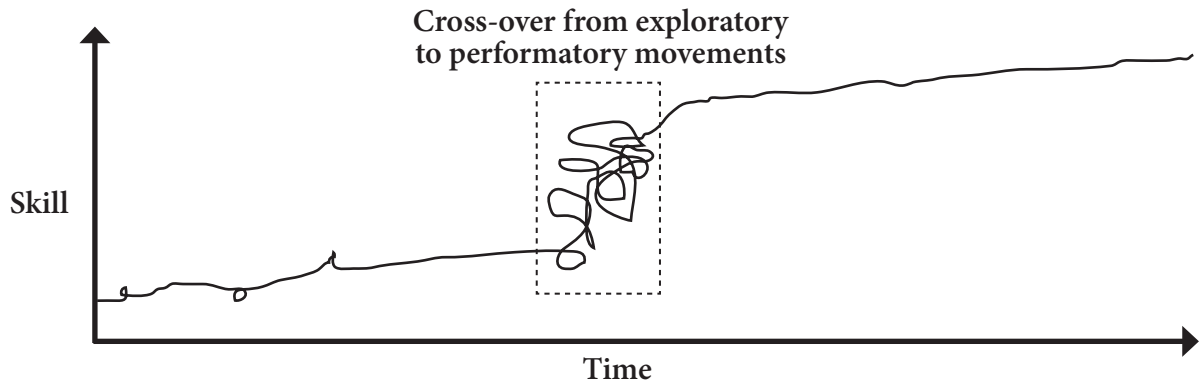


**Figure 2:** To sketch, as a line, the changes in the qualities of movements in response to haptic affordances over time would suggest a link between movement and enskilment. The cross-over between exploratory and performatory movements, would be different for each product-user-environment combination and the steepness of the curve could be an indicator of the potential for growth of skill.

## CONCLUSION

In this paper we show a connection between perception (visual and haptic) and movement, which in turn links to bodily skill over time. We believe that the role of haptic affordances changes when a person becomes skilled (Figure 2). It starts out as the education of attention with a focus on discovery and learning (mainly exploratory movements). This makes use of nested affordances in the environment. When skill has developed, the movements change to performatory as in everyday manipulation with a focus on timing – a manipulation of the spatial to achieve the temporal. This is a processional process that anticipates the next step without becoming a robotic-like movement because of the need to take into account the coordination of skilled perception as well as skilled movement (motor capacity).
As Ingold (2006, p. 76) notes:

> In a fluent performance, it has a rhythmic quality (Leroi-Gourhan, 1993: 309-310). This quality does not, however, lie in the repetitiveness of the movement itself. For there to be rhythm, movement must be embodied. Feeling lies in the coupling of movement and perception that, as we have seen, is the key to skilled practice.

This contribution shows that, from an ecological perspective, the perception of an affordance is crucially connected with an understanding of how to use it. Further more, we want to inspire designers to reflect on alternative ways of communicating the intentions of their products and systems; besides simply using semantics in order to create messages to explain how the products work and should be used.

## REFERENCES

Carterette, E. C. and M. P. Friedman (1978). Perceptual Coding, volume 8. Handbook of perception. New York, Academic Press.

Gaver, W. W. (1991). Technology Affordances. In: Robertson, Scott P., Olson, Gary M., Olson, Judith S. (ed.): Proceedings of the ACM CHI 91 Human Factors in Computing Systems Conference. April 28 - June 5, 1991, New Orleans, Louisiana: 79-84.

Gibson, J. J. (1966). The Senses Considered as Perceptual Systems. Boston, Massachusetts, Houghton Mifflin.

Gibson, J. J. (1979). The Ecological Approach to Visual Perception. New Jersey, USA, Lawrence Erlbaum Associates.

Grasseni, C. (2006). Skilled Visions: Between Apprenticeship and Standards, Grasseni, C. (ed). New York: Berghahn Books.

Ingold, T. (2001). Beyond art and technology: the anthropology of skill. In Anthropological perspectives on technology, M.B. Schiffer. Albuquerque, New Mexico, University of New Mexico Press: 17-31.

Ingold, T. 2006. Walking the plank: Meditations on a process of skill. In J.R. Dakers (ed), Defining technological literacy: Towards an epistemological framework. New York: Palgrave Macmillan.

Krippendorff, K. and R. Butter (1984). Product semantics. Exploring the symbolic qualities of form. The Journal of Industrial Designers Society of America: 4-9.

Lave, J. and Wenger, E. 1991. Situated learning: legitimate peripheral participation. Cambridge: Cambridge University Press.

McGrenere, Joanna, Ho, Wayne (2000). Affordances: Clarifying and Evolving a Concept. In: Proceedings of Graphics Interface 2000. May 15-17, 2000, Montreal, Quebec, Canada: 179-186.

Norman, D.A. (1988). The Psychology of Everyday Things. New York, Basic Books.

Révész, G. (1950). Psychology and Art of the Blind. London, Longmans Green.

Rizzo, A. (2006). The Origin and Design of Intentional Affordances. In: Proceedings of DIS 2006, June 26-28, 2006, Pennsylvania, USA.

Rubin, D. C. (1988). Go for the skill. In Remembering reconsidered: Ecological and traditional approaches to the study of memory, U. Neisser and E. Winograd (eds.). Cambridge, Cambridge University Press, 374-382.

You, H., and Chen, K. (2006). Applications of affordance and semantics in product design. Design Studies, doi:10.1016/j.destud.2006.07.002

Zaff, B.S. (1995). Designing with Affordances in Mind. In: Global Perspectives on the Ecology of Human-machine Systems, Flach, J., Hancock, P., Caird, J. and K. Vicente (eds). Hillsdale, New Jersey, Lawrence Erlbaum Associates: 238-272.