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Research Paper

Affordances in Human-Computer Interaction Design

Good designs are intuitive. What is the secret of making designs intuitive? An essential part of it has to do with perception. It is not sufficient for a good design to be rational and logical. Great, intuitive designs are those that allow us directly, and correctly, to see what we can do with a thing. Direct perception of possibilities for action is, essentially, what the concept of affordance is about. The concept was originally proposed by James Gibson to denote what the environment “offers the animal, what it provides or furnishes, either for good or ill” (Gibson, 1979). The concept was introduced to the field of design, and eventually Human-Computer Interaction (HCI), by Donald Norman in his groundbreaking book *The Psychology of Everyday Things* (1988). Norman defined affordances as: “... the perceived or actual properties of the thing, primarily those fundamental properties that determine just how the things could possibly be used.” The concept of affordances was quickly adopted in HCI and interaction design; it became popular among practitioners, researchers, and educators. For designers of interactive technologies, the concept signified the promise of exploiting the power of perception in order to make everyday things more intuitive and, in general, more usable. Affordance is also considered a fundamental concept in HCI research and described as a basic design principle in HCI and interaction design textbooks. This paper is going to discuss the concepts of affordances and how it has been used in HCI; it explores the continuing debate in HCI research concerning theoretical interpretations and design implications of the concept.

The concept of affordance was proposed by James Gibson (1977, 1979) as part of his ecological approach to visual perception. A key idea underlying Gibson's approach is mutuality of animal and environment. Animal and environment are 2 parts of a whole system: one of them implies the other. There is a coupling between animals' anatomy and behavior, on the one hand, and the structure of their environments, on the other, which makes it possible for the animals to survive and successfully act in the environments. Affordances are determined by both the environment and the animal. For instance, a chair affords sitting to animals having certain bodies – in other words, for such animals it is seatable. An affordance is a property of the environment – it can be measured and studied objectively. At the same time, it is a relational property – it is determined by the relationship between animal and environment rather than by the environment alone. It should be emphasized that Gibson was not interested in affordances per se. To him, affordances were relevant only to the extent to which they could help provide an account of how animals perceive their environments. Gibson's approach does not make a fundamental distinction between human beings and other animals. The assumption of the mutuality of animal and environment, as well as the arguments based on this assumption, which lay out the foundation of the theory of affordances, are general enough to be applicable to any animal. Some examples of affordances described by Gibson are related to specifically human objects, such as mailboxes, and he paid special attention to a variety of tools, including scissors, knives, and clubs. However, these affordances are considered similar to affordances provided by "natural" objects to non-human animals.

Broadly speaking, the concept of affordances in HCI is used in 3 related but distinct research agendas, which are predominantly concerned with understanding and supporting, respectively: (a) direct perception, (b) purposeful user action in general, and (c) meaning making.

Each of these concerns is associated with a particular perspective on affordances. Supporting direct perception of suitable user actions was the original rationale behind bringing the concept of affordances to HCI (Norman, 1988; Gaver, 1991). The interpretation of affordances in this research agenda is close to the Gibsonian notion, except that “direct perception” is not necessarily understood in the Gibsonian anti-representationalist sense; it can simply mean that no label or instruction is needed to figure out how to use an artifact (Norman, 1988). Using affordances as an analytical tool to develop technological support for purposeful human action in general is an extension of the direct perception. There are 2 general strategies of using affordances as such an analytical tool. The first strategy is to (a) provide a system of hierarchically organized affordances, that is, action possibilities, which jointly enable the user to attain their meaningful goals and (b) support the user in perceiving these action possibilities (Vicente and Rasmussen, 1990; McGrenere and Ho, 2000). The second strategy is to focus on the “execution-evaluation” cycle of one particular action. The cycle is broken down into specific stages using the model of action, proposed by Norman (1988) and the concept of affordances is applied to identify possible ways of supporting the user at each of these stages. Irrespective of the strategy, perception is playing a key role in the analysis. However, the difference between “direct” and “indirect” perception is usually of secondary importance. Finally, in a number of relatively recent studies (Turner, 2005; Rizzo, 2006), it is proposed that the scope of the concept be extended even further, to include meaning making in social context. Notions of affordances based on the original Gibsonian concept, are considered limited, as only describing the most basic types of affordances. It is argued that there is a need for a more advanced notion, according to which affordances are understood as emerging possibilities for individual and collective action in social and cultural contexts, actively constructed by technology users in their everyday

practices through both doing and interpretation. The main focus of analysis in this research agenda is not on the “perception-action” cycle but rather on how people generally make sense of the world in terms of action possibilities provided by the environment.

Gibson’s ecological approach specifically and explicitly deals with perceiving and acting animals. The key concepts of the approach, including affordances, are defined in terms of animal-environment interaction. While a variety of illustrating examples, provided by Gibson himself and other proponents of his approach, refer to specifically human objects, such as knives, mailboxes, stairs, airplanes, pictures, and so forth, interaction with these objects is analyzed within the same general framework as interaction of other animals with objects in their respective ecological niches. This perspective is characteristic for much work in ecological psychology in general. Of course, it is true that we are animals, and this fact has deep implications for how our man-made world is created and experienced. Our built environments, as well as individual things comprising the environments, are as they are to a large extent because we are animals equipped with certain bodies, hands, motor functions, and senses. If we were a different kind of animal, then our houses, cars, airplanes, and computers, if we had them, would look different. Undoubtedly, when designing interactive products, it is important to take into account what ways of action are natural for us as a certain animal species. However, we humans are also fundamentally unique in a number of respects. As opposed to other animals we are social, cultural creatures: we use language, take part in socially organized collective activities, and employ various artifacts that other animals do not have. Considering humans as just another animal species is increasingly perceived as a major limitation of Gibson’s theory of affordances in HCI. A key challenge for future research on affordances in HCI appears to be taking into

account the context of culture in order to understand how possibilities for human action are created, perceived, and can be supported by appropriately designed technology.

A common assumption about affordances is that perceiving them does not usually require much learning; an ability to directly understand affordances is something that we all have. Without any instruction, we can see that cliffs afford falling off, small stones afford throwing, and chairs afford sitting. The assumed independence of learning has probably been one of the reasons behind the popularity of affordances among designers. However, that assumption is actually a misconception. When animals are born into the world, their perceptual functions are rudimentary and action capabilities extremely limited. It is only through maturation and practice that they acquire both the ability to act and the ability to pick up information about emerging affordances. Moreover, individual life conditions even for animals of the same species can be very different, so that different affordances are provided to and have to be perceived by the animals. Therefore, for an individual animal the ability to perceive an affordance is not something that can be taken for granted but rather an accomplishment, a result of learning and development. Studies of perceptual learning and development, conducted within the general framework of Gibson's ecological approach by Eleanor Gibson and her colleagues, undoubtedly provide important insights into the centrality of learning in the perception of affordances. Explicitly taking affordances into account means that supporting users' discovery of affordances and learning how to use them should be a key designer's concern. Currently there is a lack of evidence on how exactly people learn, unlearn, and re-learn new affordances.

A major problem with current explorations of affordances in HCI is the uncertainty resulting from diverse interpretations of the term in the field. To be a useful conceptual tool, new interpretations of affordances, as well as other proposed concepts, need to be clearly presented

and explicitly compared to other interpretations, especially the original Gibsonian meaning, and positioned in a specific research context. Another important challenge is to make sure a concept is practically relevant and useful, that it provides new insights that help practitioners deal with concrete problems of analysis, design, evaluation, and appropriation of interactive technologies. Arguably, nowadays, users are not particularly puzzled by individual interface objects. Instead, they may find it challenging to discover and learn complex configurations of affordances, organized in time and space, assess the effort needed to act out an affordance, and relate mutual affordances of a tool and object of interest to see what action possibilities are offered by the tool. A limitation of theoretical analyses of affordances is that they seldom result in the development of analytical tools suitable for concrete task analysis, design, and evaluation of technology in practical contexts.

Overall, this paper has briefly walked through the history and main points of Gibson's theory of affordances, overviewed selected analyses of affordances in HCI research, went over issues of debate (culture and learning), and reflected on the present and future of the concept of affordances in HCI and interaction design. In sum, the main challenges for employing new conceptualizations of affordances in HCI include clarifying the meaning of the concept, as well as its place within a certain research agenda, and making it useful and relevant to designers and other HCI practitioners. Whether or not it can be achieved appears to be critical for determining the future of affordances as an HCI concept.

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