

Cognitively describing and designing affordances

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The term affordance carries different meanings within design communities. Traditionally, affordances were discussed within a Gibsonian framework in which affordances arise from direct perception. Some authors now describe affordances as being mostly perceptual while others describe them as being culturally bound. We suggest that both of these descriptions are correct and that they can be explained from a cognitive conceptualization of perceived affordances. We suggest that perceived affordances are supported by automatic perceptual processes in the user developed over time through consistent interactions with the environment. Design consistency is critical for producing effortless usage, because interaction consistency facilitates the formation of long-term memory structures. We explore the underlying mechanisms that could explain how affordances arise and affect the cognitive system.

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We discuss automatization, a characteristic of the cognitive system that *supports* effortless experience of perceived affordances because it allows rapid activation of knowledge without intention. Automatic processing requires minimal limited capacity working memory resources that define a bottleneck in awareness or controlled processing; the primary requirement for developing an automatic process is consistency of a stimulus–response mapping. We propose that when a design produces highly consistent interactions, the cognitive pattern recognition system learns to automatically identify the constraints. We are not interested in any specific type of constraint (e.g., physical, social, logical, cultural, semantic); rather, we are interested in the cognitive effect of a constraint's being in play. In this article, we describe a cognitive conceptualization of affordance, including the resource limitations of working memory, the role long-term memory plays in perception, and the difference between automatic and controlled processing; we show how this perspective provides valuable insight into affordances; and we conclude by demonstrating how the cognitive attributes of a perceived

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affordance relate to design outcomes. Part of our description is in the form of a flowchart depicting the automatization process and development of representations that allow perceived affordances.

1 Affordances

1.1 Why consider affordances?

The term *affordance* was first introduced to the design community through Donald Norman's (1988) book *The Psychology of Everyday Things* (POET). According to Norman (1988, p. 219), '[perceived] affordances result from the mental interpretations of things, based on our past knowledge and experience applied to our perception of the things about us.' The concept of affordances was widely adopted in the design literature, but Norman (1999) stated that the meaning of affordance had been overly and incorrectly used. As noted by McGrenere and Ho (2000), the term had taken on a number of different meanings far from the original meaning proposed by Gibson (1979). The overuse of the term was a major concern for Norman (1999) who stated that, 'Sloppy thinking about the concepts and tactics often leads to sloppiness in design. And sloppiness in design translates into confusion for users' (p. 41). Despite this 'sloppiness', the recognition of affordances within the HCI community has led to better designs. For example, designers have used perceived affordances to provide intuitive visual instructions for users and thereby avoided the need to explain how to use simple everyday things. However, several important questions remain to be investigated, one of which is how is an affordance integrated into and how does it operate within the user's cognitive system? According to Sheridan (2007, p. 17), 'Gibson's affordances are opportunities for action made available by observations of (attraction of attention to) the external environment, whereas stored information (as a basis for decision to allocate attention) is internal. Obviously, the two must somehow coordinate (which we wish we understood better!).' Our view is that the coordination results from automatization.

1.2 The original meaning of affordance

Several meanings of the term affordance appear in the literature. J. J. Gibson originally conceived of the idea of an affordance and his conception of an affordance is still the most often referenced meaning. According to Gibson (1979, p. 127), 'The *affordances* of the environment are what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill. The verb to afford is found in the dictionary, but the noun *affordance* is not. I have made it up. I mean by it something that refers both [to] the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment.' We note here that the term affordance refers to an apparent relationship. From a design perspective, affordances require both a user and an artifact.

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