

EXPLORING AFFORDANCES

Exploring the Concept of Affordances

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Introduction

This paper will examine psychologist James J. Gibson's theory of affordances (Gibson, 1977, 1979). This theory explains that humans perceive the world not only in terms of objects and spatial relationships but that humans can also perceive an object's possibilities for action.

Affordances are clues in the environment that point toward a possibility for action. Affordances are perceived directly and do not require any further sensory processing (Gibson, 1977). Examples include: handles for pulling, buttons for pushing, and knobs for turning. Because perception of the environment can lead to a course of action; this means that perception alone can drive action.

Affordance theory has many implications for education, design, human-computer interaction, ergonomics, and visualization. This has special implications for Instructional Design because the theory would suggest that, "When affordances are taken advantage of, the user knows what to do just by looking: no picture, label, or instruction is needed" (Norman, 1988, p.9).

This paper will provide a historical overview of the development of the theory. In addition, this paper will look at efforts to clarify the definition of "affordance." According to McGrenere and Ho (2000), "As the concept of affordances is used currently, it has marginal value, because it lacks specific meaning" (p.8).

The paper will also explore possible strategies for using affordances with a constructionist approach using the ADDIE model. This is being done to explore how the theory can help instructional designers succeed in creating more effective learning environments.

Literature Review

This section of the paper gives an overview of the historical information concerning the origins of the word “affordance,” and the development of various definitions by different scholars. This review will attempt to list most of the major articles, essays and books that have helped to shape and solidify the concept of affordances.

Gibson’s Affordances

The origins of the affordance theory began with Gibson’s investigation, in the 1950’s, of depth perception and the way that fighter pilots figured out how to land their planes. In his book, *The Perception of the Visual World*, Gibson (1950) came to the conclusion that pilots did not model the world in their heads to process and predict what was going to happen when they landed their planes. Instead the pilots used the knowledge in the world to create a relationship between themselves and things in the world to get them down safely (Hawdale, 2004).

The ideas in *Perception of the Visual World* began to develop the concept that knowledge is in the world, not the head. In fact, Gibson is often incorrectly quoted as saying, “Ask not what’s inside your head, but what your head’s inside of.” These are *not* Gibson’s own words. This is a paraphrase made by William Mace (1977, p. 43) to describe Gibson’s concept.

Gibson introduced the word *affordance* in his 1977 article, “The Theory of Affordances,” that appeared in the book, *Perceiving, Acting, and Knowing: Toward an Ecological Psychology*, edited by Robert Shaw and John Bransford. Gibson’s ideas

about affordance were later fully developed in the book, *The Ecological Approach to Visual Perception* (Gibson, 1979).

Gibson (1979) wrote:

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 to both the environment and the animal in a way that no existing term does. It implies the complementarity [sic] of the animal and the environment (p. 127).

Gibson (1977) defined affordances as all *action possibilities* underlying in the environment. These possibilities are measurable objectively and are not dependent on an individual's (or actor's) ability to recognize them. However, these possibilities are always in relationship to the actor and are dependent on the actor's capabilities (Gibson, 1977). For example, a set of steps which rises four feet high does not afford the act of climbing if the actor is an infant crawling on all fours.

The origin of the concept of affordances grew from Gestalt psychology, according to Gibson (1979). In the book, *Principals of Gestalt Psychology*, Koffka (1935) wrote about what he called the *demand character* of an object. "Each thing says what it is...a fruit says, 'Eat me'; water says, 'Drink me'; thunder says, 'Fear me'; and woman says, 'Love me'" (p. 7). Things, "...tell us what to do with them" (p. 353).

Gibson was a leader in the Ecological (environmental) Psychology movement. He argued that animals and humans exist in a systems relation to the environment. Therefore, to fully explain some behavior it is necessary to study the environment in which this behavior took place. An affordance points to both the environment and the observer (Gibson, 1979).

Gibson (1979) also wrote about the idea of a niche:

Ecologists have the concept of a *niche*. A species of animal is said to utilize or occupy a certain niche in the environment. This is not quite the same as the habitat of the species; a niche refers more to *how* and animal lives than to *where* it lives. I suggest that a niche is a set of affordances (p. 132).

Norman's Affordances

Although Gibson coined the word affordance, it was Donald A. Norman who popularized use of the term in the design and human computer interface (HCI) communities. Norman's opinion was that an affordance was the design aspect of an object that suggested how an object could be used (Norman, 1988). Norman wrote about affordances in his book, *The Psychology of Everyday Things*. In his book Norman (1988) states that an affordance refers principally to the fundamental properties of an object.

"The term affordance refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used," wrote Norman (1988). "A chair affords (is for) support and, therefore affords sitting" (p. 9).

Norman differs from Gibson's view in that the frame of reference for Gibson is the action capabilities of the actor. But for Norman the frame of reference is the mental and perceptual capabilities of the actor (McGrenere & Ho, 2000). Gibson also states that the existence of affordances is not dependant on an actor's experience and culture. Norman, however, tightly links affordances with the past knowledge and experience of an actor.

Gibson's and Norman's different approaches to affordances is clearly shown (in the form of a table) in McGrenere and Ho's, article, *Affordances: Clarifying and Evolving a Concept* (2000, p. 3).

Gibson's Affordances

- Offerings or action possibilities in the environment in relation to the action capabilities of an actor
- Independent of the actor's experience, knowledge, culture, or ability to perceive
- Existence is binary – an affordance exists or it does not exist

Norman's Affordances

- Perceived properties that may or may not actually exist
- Suggestions or clues as to how to use the properties
- Can be dependent on the experience, knowledge, or culture of the actor
- Can make an action difficult or easy

According to McGrenere and Ho, the basic difference between Gibson and Norman is that Gibson is mainly interested in how actors perceive their environments. Norman, however, is mainly interested in how actors can change or *design* their environments so that utility can be perceived easily (McGrenere & Ho, 2000).

Norman went beyond affordances in *The Psychology of Everyday Things* (POET). In POET, Norman argued that understanding how to operate a novel device had three major dimensions: conceptual models, constraints, and affordances (Norman, 1988). In his article, *Affordance, Conventions and Design (Part 2)*, Norman (1999) reflected on POET and explained that the *most* important part of a good design is the conceptual model. However, since POET was published there was only a “token acceptance” of this

conceptual model (Norman, 1999, p. 39). The power of using constraints explained in POET was largely ignored.

The only concept that “caught on” was affordances, according to Norman (1999):

To my great surprise, the concept of affordances was adopted by the design community, especially graphic and industrial design. The concept has caught on, but not always with complete understanding. My fault: I was really talking about perceived affordances, which are not at all the same as real ones (p. 39).

Norman (1999) explained that a designer should care more about what actions the user perceives to be possible, than the actions that are actually possible. When you deal with real, physical objects (like in product design) there can be both real and perceived affordances, and these two sets of affordance are not always the same (Norman, 1999).

Norman (2008) later argued that affordances should be replaced by *signifiers*. In his online essay, *Signifiers, Not Affordances*, Norman (2008) explained that the concept of affordances works well for physical objects, but not for people, situations, social groups, or cultures. A signifier is a kind of indicator or clue in the physical or social world that can be interpreted meaningfully, wrote Norman (2008). Social signifiers are those clues that are relevant to social usages, and these replace affordances, because signifiers are broader and richer (Norman, 2008).

Norman (2008) explained that signifiers help us find our way in the world:

We are all detectives, searching for clues to enable us to function in this complex world. Whether it is flags waving in the wind, the difference between empty or crowded train platforms, or the desire lines illustrated by footprints in the fields that suggest paths to follow, we search for significant signs in the world that offer

guidance. In the social world comprised of people and technology, these cues are social signifiers (para. 9).

Because people search for clues that might help them cope and understand the world, then it is the job of a good designer to provide these clues. Norman (2008) wrote, “Forget affordances: what people need, and what design must provide, are signifiers” (para. 8).

Other Viewpoints about Affordances

Over the years other researchers and psychologists have attempted to formally define affordances. Michael T. Turvey’s formal definition of affordances is based on an ontological perspective that affordances are properties of an environment (Turvey, 1992). In 2003 Thomas A. Stoffregen proposed a formal alternative to Turvey’s definition. Stoffregen’s definition is explicitly based on an ontological perspective that affordances are relational or emergent properties of animal–environment systems (Stoffregen, 2003). Other important voices in the affordance debate include William W. Gaver and William H. Warren.

Gaver (1991) explored the idea of complex, or nested, affordances. Nested affordances are those that are grouped in space. These are often sequential affordances that are revealed over time. A software example of this would be multiple, linked drop-down menus. Gaver (1991) also divided affordances into three categories. These include perceptible affordances, hidden affordances, and false affordances. An example of a hidden affordance would be a concealed trapdoor. The door has the possibility for action, but since it is concealed from the actor, its affordance is hidden. A false affordance, on the other hand, only has the *apparent* possibility for action, but does not have any real

function. An example of a false affordance would be hyper-linked text, that when clicked does not *link* to anything.

Warren (1984) pioneered the idea of using of pi numbers to describe affordances. Warren did a series of stair-climbing affordance studies. In his studies Warren (1984) looked at affordances as relationships between an actor (leg length) and the environment (stair riser height) and characterized those relationships using a ratio. He found that judgments of climbability [sic] did not vary with leg length or riser height but with the ratio (Warren, 1984). This is an important concept in using affordance in the fields of HCI and robotics. Because the relation between two things remains common even when specific details change, you can use ratios (eliminating specific units) and rescale numbers within any system (Warren, 1984).

Working to Clarify Affordances

Since Gibson only laid out the basic concept of affordances (without a formal definition) and since others, like Norman, have changed and evolved the concept, there has been a lot of confusion in regard to the term – *affordance*. Several researchers and psychologists have written about the importance of clarifying exactly what affordance should mean.

McGrenere and Ho, 2000.

A major contribution to the literature in this regard comes from Joanna McGrenere and Wayne Ho. Their 2000 paper entitled, *Affordances: Clarifying and Evolving a Concept*, is a must read for anyone wishing to explore the idea of affordances.

McGrenere and Ho describe, in minute detail, both Gibson's and Norman's concept of affordances and highlight and interpret the differences between their two

approaches. In the paper the authors point out that, “Most who cite Gibson and perhaps even quote him resort to using the meaning given by Norman” (McGrenere & Ho, 2000, p. 5). The paper also acknowledges Gaver’s contributions to the affordance debate and discusses the usefulness and usability of the term.

McGrenere and Ho (2000) concluded that returning to a definition close to that of Gibson’s would solidify the concept of affordance. And in order for the affordance concept to be used fully in the design world that Gibson’s definition needs to incorporate the notion of varying degrees of affordances (McGrenere & Ho, 2000). The authors also stressed that establishing a clear meaning of affordances really matters, because a concrete meaning will prevent misunderstandings and the widely varying uses of the term (McGrenere & Ho, 2000). This need for clarification is important for both designers and for end users. Norman, himself stressed that designers must work harder to clear up confusion about the concept of affordance. “Sloppy thinking about the concepts and tactics often leads to sloppiness in design. And sloppiness in design translates into confusion for users,” wrote Norman (1999, p. 41).

Hartson, 2003.

Another major contribution to the literature regarding affordances comes from H. Rex Hartson. His 2003 paper entitled, *Cognitive, Physical, Sensory, and Functional Affordances in Interaction Design*, affirms the importance of having a clear definition of the concept and builds upon the ideas of Norman. Hartson (2003) stressed that the term affordance has been used with, “more enthusiasm than knowledge” (p. 336). In his paper, Hartson mainly focuses on Norman’s definition of affordance, but also provides background information about Gibson’s, Gaver’s and McGrenere and Ho’s work.

Hartson goes on to expand the definition of affordance in the context of interaction design with his own four complementary types of affordances. These include: cognitive affordance, physical affordance, sensory affordance, and functional affordance (Hartson, 2003). Hartson defines each of these complementary affordances in the following way:

- A cognitive affordance is a design feature that helps, aids, supports, facilitates, or enables thinking and/or knowing about something (p. 319).
- A physical affordance is a design feature that helps, aids, supports, facilitates, or enables physically doing something (p. 319).
- A sensory affordance is a design feature that helps, aids, supports, facilitates, or enables the user in sensing (e.g., seeing, hearing, feeling) something (p. 322).
- A functional affordance is a design feature that helps users accomplish work (p. 323).

Hartson explains the four types of affordances complement each other naturally. He goes on to provide designers with guidelines to help them think about how the four affordances can work together in contextualized HCI design or evaluation (Hartson, 2003).

Using Affordances in the Classroom

Educators who have a clear understanding of affordances can use this knowledge to help design instructional materials. If designers can take advantage of both real and perceived affordances, then they can create learning environments where students *know* what to do without additional guidance from an instructor. In using the term affordance

in this section of the paper, I am referring to the definition and work of Norman (1988, 1999) and Hartman (2003).

Using the ADDIE Model

Actual affordances (in physical classrooms) and perceived affordances (in online environments) can be considered when using the ADDIE Model (Molenda, 2003) of developing instructional materials. All five phases—Analysis, Design, Development, Implementation, and Evaluation—could take advantage of affordances if a concerted design effort is made.

- In the analysis phase designers should become aware of the experience, knowledge, or culture of their students. This will help determine if an affordance could be *perceived*.
- In the design phase instructors can use strategies targeted at using affordances in a systematic way. This can occur when choosing media or creating exercises.
- In the development phase, when developers create and assemble class content, designers can place affordances to help guide students seamlessly through content.
- In the implementation phase designers need to ensure both teachers and students are aware of affordances that have been integrated into different teaching tools.
- In the evaluation phase designers need to use both formative and summative evaluations to generate feedback and determine if *placed* affordances were successful.

Designers should use any and all affordances (real or perceived) including cognitive, physical, and sensory affordances (Hartman, 2003). Whatever approach is used, all

affordances should be *functional affordances* that help students accomplish work (Hartman, 2003). When evaluating the effectiveness of affordances, designers have to determine if students *viewed* the affordance as perceptible, hidden, or false affordances (Gaver, 1991). Affordances that are hidden or false must be fixed or removed.

The Constructionist Approach

Affordances could be especially effective if used in concert with a constructionist approach to instructional design. Seymour Papert, a leader in the development of Constructionism, wrote that children learn best when they are in the active role of the designer and constructor of their own knowledge (Papert & Harel, 1991).

This approach places teachers in the role of guides or facilitators. By actively designing affordances into instructional materials, teachers can effectively guide a student's progress as they make discoveries for themselves. Well placed affordances should be natural, almost invisible, to students allowing them to make their own connections and actively (but not blindly) create their own knowledge.

Norman (n.d.) summed up this approach in his essay, *Learning from the Success of Computer Games*:

We learn not by having our heads filled with the great thoughts and ideas of others, but by constructing them within our own conceptual structures. But this construction works best when the scenario is rigged so as to lead us to the ideas, to force us to confront them and understand them. This is what the successful game designer does. This is what the successful educator must do (para. 5).

A Personal Viewpoint

After learning more about affordances than I ever imagined, I have come up with my own personal viewpoint about using the theory of affordance. I personally would choose to use affordances to help *stage manage* or guide my students in creating their own knowledge using a constructionist approach. I would use affordances for three primary purposes: to attract, to direct, and to connect.

First, I could use affordance to attract attention with an object (real or screen-based) that naturally demands attention (a button to push, or a door to open). Next, I can use affordances that naturally provide direction (arrows, virtual stair steps, or nested menus). Lastly I can use affordances to help students to *connect the dots* and create their own connections (comparison tables, charts, before and after illustrations). The ultimate goal is to provide clues, suggestions, and signs that help to invisibly guide students to create their own knowledge.

I also understand now that using affordances alone is not enough. There is no reason to use a single tool when there are other ways to help guide students. You can use affordances, constraints, and mapping all together to help guide students. Norman (1988) used a pair of scissors as an example to explain these elements. The holes in the scissors are the affordances and the size of the holes provide constraints to limit which fingers you can use. Mapping allows us to figure out which fingers will fit into which holes. Used all together these elements allow us to create a conceptual model of how the scissors could operate. A conceptual model is the mental image that we form that helps us predict how an object, system, or process works. Norman (1988) wrote, "A good

conceptual model allows us to predict the effects of our actions. Without a good model we operate by rote, blindly” (p.13).

Conclusion

This paper examined Gibson’s theory of affordances. This theory explains that humans can perceive an object’s possibilities for action, and that perception alone can drive action.

Using affordances does have special implications for IDT because the theory suggests that if affordances are taken advantage of, students could know what to do “...just by looking: no picture, label, or instruction is needed” (Norman, 1988, p.9).

This paper also provided a historical overview of the development of the theory, and looked at the many efforts to clarify the concept and definition of affordance. This paper showed that there is still a lot of misunderstanding and misuse of the word affordance, and that researchers are still struggling to come up with a formal definition of the affordance theory that will be widely accepted and utilized.

This paper also explored some possible strategies for using affordances with a constructionist approach using the ADDIE model. This paper was written to explore how affordances could help instructional designers succeed in creating more effective learning environments.

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