A Remedy Called Affordance

AVANT, Vol. III, No. 2/2012
ISSN: 2082-6710 avant.edu.pl/en

What will you do to me when you see me?
Perception as searching for affordances in the environment

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Received 12 December 2012; accepted 15 December 2012; published online 27 December 2012.

translated by Monika Włudzik

Abstract

Contemporary research on action-perception coupling draws on Gibson's concept of affordances. The text outlines the conceptual basis of this issue, showing how the notion of affordance is embraced in the theory of perception, understood as an active search for structured information that could improve the functioning of the organism in the environment. It also mentions a philosophical parallel (Martin Heidegger's philosophy of tools) and concludes that the intuitions behind the concept of affordances have been more inspiring to cognitive scientists, neuroscientists and researchers in robotics than to psychologists studying perception.

Keywords: affordance, information pickup, tool use, tool perception.

Let us imagine that we have found ourselves in an unfamiliar room and we are looking around. What guides our sight when we look around? Do we want to reduce our ignorance and find out where we are? Or, perhaps, visual perception is itself part of an activity that has begun earlier[1] and that requires using perceptual information to plan and execute subsequent tasks? The following reply suggests itself: vision as cognition and visually guided action are two closely connected processes. The first one focuses on acquiring knowledge. This process comes down to receiving and processing sensory information long enough for a conscious percept to appear. After conscious perceptual knowledge is obtained, it can be used in various ways, including a con-

[1] After all, finding oneself in such a room is a result of prior activity. For instance, we have been looking for somebody (an acquaintance, a thief, a terrorist) or something (food, valuables, explosives), we have been following somebody, we have been invited or forced to go inside, etc. The situation that results in the fact that we are in an unknown room also influences the way we are looking around the room. The way we look at the visual scene depends on what we are looking for. Our behavior is different when we look for something we know and when we attempt to find something new, unknown to us that "disturbs" the scene we recognize. We can look around cautiously or fearlessly, look down, ahead or up, stand upright, bend, crouch, stand on the toes, revolve around our axis or walk around the room. In each of these and in similar cases, a visually reconstructed scene will be different, and the divergences will be the result of the fact that its construction depends on previous states and purposes we intend to fulfill.

scious support of action. The case of visually guided action, is completely different. In such cases subjects unconsciously exert perceptual control[2] over the components of their behavior to achieve the expected results which in effect change their surroundings. The chances of obtaining such results increase if the perceivers can skillfully select and process sensory information. Although the approach that intertwines perception and action seems to be natural and convincing, its use is limited, as it is not clear how this attractive vision can be transformed into an effective research program with specified theoretical models. It should not be limited to casual declarations regarding the relations between perception and action, but should give them the form of scientifically testable theses. Transforming intuitions into theory (a collection of hypotheses) would allow us to specify the nature of these relations and, as a result, to design experiments that could test this theory. If we content ourselves with bare intuitions about action-perception coupling, we will not be able to differentiate between standard cases, wherein action supports perception or perception supports action, from non-standard ones, wherein the adequacy of perception requires withholding action or the efficacy of action requires negligence of perceptual data. Perceptual activities such as reading a text, looking at a painting or watching a film belong to the first group, as recognizing letters or following changes between pictures requires refraining from or minimizing motor behavior and taking a position at a particular point in space. In the second group of situations, the efficiency of action depends upon the access to sensory data that we are entirely unaware of due to the specificity of circumstances. Typical examples of these include motor skills of sportsmen (returning the ball in tennis, coordinating actions in team sports, e.g. passing the ball to another team member or the way defenders react to a feint made by the forward) as well as behavior in everyday situations, such as using cutlery during a meal, writing with a fountain pen or auditory control of speech production. There is no doubt that without an access to sensory data and without using them, such activities will end in failure. Interestingly, the sensory data necessary for efficient action often differ from those which are used to construct a conscious percept. Moreover, the requirements of efficacy and smoothness of action, as well as time constraints, compel us to unconsciously select and process the content of such data. It has been shown, for instance, that certain visually guided actions are not affected by perceptual illusions (Kroliczak et al. 2006)[3].

Facing difficulties involved in constructing a unified conception of perception and action, researchers have usually decided to investigate each form of activity separately. The task of finding out how the two interact has been postponed until basic regularities will have been established separately for each type of activity. This approach has also shaped the way research has been conducted. In the case of research on percep-

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[2] Conscious control would last too long and would disturb the flow of activity.

[3] It should be noted that efficient reading requires being at rest, as well as making learned and automatic movements of the eyes and the head. Moreover, this is an impoverished form of visual perception, because it is confined to a rapid identification of standardised graphic signs and their sequences located on a flat surface. On the other hand, the efficacy of actions controlled visually (reaching, grasping, writing by hand, eating with chopsticks or knife and fork, using tools, but also walking, dancing etc.) depends on a correct assessment of distance as well as on a spatio-temporal coordination. These assessments have to be accurate and, therefore, visually guided action is not affected by illusory data. (Milner & Goodale 2006).

tion, this has amounted to privileging static situations that involved a subject sitting in front of a screen and looking at simple graphic signs or pictures. Such a radical simplification of experimental setting was modeled after natural sciences and has resulted in a drastic reduction of the number and the complexity of investigated factors. There has only been space for the factors that could be effectively controlled by researchers. It has also been assumed that taking into consideration more complex cases, such as motion of objects in a visual scene or locomotion of the observer would not introduce changes that would significantly modify the perception process.

One of the most vocal critics of this approach was James Jerome Gibson who viewed separating perception from action as a fundamental mistake. He assumed that perception itself is a kind of action and that it is undertaken in order to facilitate non-perceptual actions. He believed that isolating perception from the natural conditions in which it is used by an organism results in false accounts of the way it works. In his critique of the standard approach to perception, he pointed out that situations rarely encountered in everyday life[4] are seen as paradigmatic for perception. This way of investigative conduct rules out the chance to account for perception, because artificial situations (with radically simplified and isolated stimuli, presented to an immobile observer) are treated as models of real perceptual activities. According to Gibson (1966), traditional schools in psychology erroneously conceptualized perception as a passive reception of imposed stimulation. As a result, the organism was pictured as engaged in constructing complex percepts from simple imposed stimuli. Gibson rejected this image and claimed that stimuli in the natural environment are not as simple as those produced in the laboratory and this is the reason why organisms have not developed systems capable of correctly responding to such signals. Instead, they are equipped with systems which can react quickly and efficiently to much more complex stimuli if only these are important for their survival. Moreover, organisms are not passive receivers of stimuli, but rather they actively seek stimulation in the environment, selecting stimuli that are important for survival in their habitat. This obtained stimulation[5] has the form of structured, complex information. Therefore, the task of the organism is not to extract information from physical stimuli and transform it in a complicated procedure of multilayered processing, but rather to “understand the content of messages” broadcast by the objects in its environment.

Since perception is understood as information pickup from the environment, it should be specified in what form the information occurs and what messages are so important for the organism that it makes an effort to obtain them. Gibson rejects the idea that information can be elicited from physical stimuli reaching the organism. The intensities of physical stimuli properties received by the receptors change constantly, so registering all the changes and processing all the information contained in the data

[4] A typical experiment amounted to a static perception of simple stimulation presented in artificial, laboratory conditions.

[5] “A pure case of obtained stimulation would occur when an active individual moves his limbs or head, stretches his muscles, or scratches himself, or when, on the other hand, he pushes into the prod, looks at the light, listens to the sound, sniffs the odor, or seeks the draft of air. Imposed stimulation occurs with a passive observer. Obtained stimulation occurs with an active observer.” (Gibson 1966: 32)

would strain the computing powers of the organism. However, in these constantly changing data, there are invariant patterns[6] that refer to features of higher order and those are sought after and recognized in the process of perception. Perceptual systems are used to detect those invariants, since the information important for the organism is contained therein. It remains to be seen which information Gibson qualified as "important" for the organism[7]. What is significant for the organism are not physical properties of objects but their values or meanings[8]. It is the objects, states or events that provide the organism what it needs which are perceived as valuable. This value can be the ability to satisfy the organism's basic needs (food, drinks, shelter, sexual partner, ally, enemy), as well as the ability to satisfy more subtle needs that occur as a result of a learning process (objects edible after cooking, stimulants and other mood enhancing substances, verbal messages etc.). The organism recognizes such valuable features as located in the objects in the environment, but what they afford is assessed from the perspective of the organism's needs. Gibson proposed *affordance*[9] as the name for the object's ability to afford or to deliver that what is valuable for the organism. Framing perception as identification of affordances has radically altered the view of this process. It is no longer the process of detecting the physical properties of an object, but rather, of selecting meaningful messages broadcast by it into environment. The messages contain information regarding the possible actions that could be performed by the preceptor to obtain certain goals. Perceiving an affordance is not synonymous with becoming conscious of it, as perception is deemed successful if the perceptor knows how to make use of it in a purposeful action.

On the philosophical plane, Gibson's concept of affordances is close to Martin Heidegger's philosophy of tool use (1927/1996). The latter is more general as it concerns not only perception, but also all forms of tool use in action; moreover, it is basically an ontology of tool with a barely delineated theory of its use. For Heidegger, the classic theory of knowledge (cognition) is a special kind of tool-use theory. It encompasses

[6] When e.g. we are looking at a person running away from us, the shape and the size of his/her silhouette are constantly changing on the retina. Yet, we see this person as having a constant shape and size. The constancy of shape and size is one of typical examples of perceptual invariants provided by Gibson.

[7] "When the constant properties of constant objects are perceived (the shape, size, color, texture, composition, motion, animation, and position relative to other objects), the observer can go on to detect their *affordances*." (Gibson 1966: 285)

[8] "I have coined this word [affordance] as a substitute for *values*, a term which carries an old burden of philosophical meaning. I mean simply what things furnish, for good or ill." (Gibson 1966:285) "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: 127).

[9] "The psychologists assume that objects are *composed* of their qualities. But I now suggest that what we perceive when we look at objects are their affordances, not their qualities. We can discriminate the dimensions of difference if required to do so in an experiment, but what the object affords us is what we normally pay attention to. The special combination of qualities into which an object can be analysed is ordinarily not noticed. … The affordance of an object is what the infant begins by noticing. The meaning is observed before the substance and surface, the color and form, are seen as such. An affordance is an invariant combination of variables, and one might guess that it is easier to perceive such an invariant unit." (Gibson 1979: 134)

cases in which the user abstains from using the tool[10]. In brief, it can be said that in his philosophy Heidegger stresses the differences between a thing and a tool. A thing is a complete, autonomous physical object, while a tool is incomplete and requires a user to be complete. It is the user who can put it in motion, and thus reveal its true nature. This property of the tool to match the shape of user's body or its parts was termed by Heidegger readiness-to-hand. The tool is not recognized on the basis of its physical features, but, rather, its readiness-to-hand. When we perceive a tool we look for features that allow us to connect it with the body and make it possible to put the tool into motion by body movements. It explains why our perception focuses on finding handles, buttons, seats, pedals, etc., because these are essential parts of tools that decide on their readiness-to-hand Gibson's affordance is a counterpart of Heidegger's readiness-to-hand. It is also a feature of an incomplete object that needs to be complemented by its user. The concepts of readiness-to-hand and affordance differ in that the former refers to the objective correspondence between the tool and the user, while the latter refers to the information (message) about the tool's readiness-to-hand.

The conception of affordances, which is the most original theoretical contribution of Gibson, was initially met with moderate enthusiasm of other psychologists, attributable to the aloofness of psychological mainstream towards his ecological psychology[11]. Their coldness was caused not only by the revolutionary character of his doctrine, which entailed the rejection of previous theoretical order, but also by the vagueness of its basic concepts, starting with affordance, and a lack of clear instructions on how to test this conception empirically. The situation changed when Gibson's ideas became an inspiration for researchers working in the fields of cognitive sciences, artificial intelligence, robotics and cognitive neuroscience. As these researchers have belonged neither to psychological mainstream nor to the inner circle of ecological psychologists, they approached Gibson's works broadly, adapting his ideas to their own needs. It has turned out that after such remodeling, Gibson's theory could have been reconciled with approaches that he originally ignored or criticized. It has been demonstrated that his ideas can be expressed in the language of computational theory (Marr 1982, Wells 2002), as well as reconciled with the theory of two visual systems (Norman 2002), or with situation semantics of Barwise and Perry (Chemero 2003). In this circular manner, the theory of affordances has returned to psychology, where it acts like yeast and continues to stimulate new empirical research as well as new theoretical proposal, as the articles published in the present volume demonstrate.

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[10] According to Heidegger, cognition in general and perception in particular are forms of being alongside things (*Sein bei*). To perceive effectively and accurately we should refrain from taking any actions towards the object. Actions produce disturbances, while refraining from action allows for an undisturbed insight into the features of the perceived object. These cognitive attitudes significantly differ from the standard, instrumental relations to objects (things). "In refraining from all production, manipulation and so on, taking care of things places itself in the only mode of being-in which is left over, in the mode of simply lingering with... *On the basis* of this kind of being toward the world solely in their mere *outward appearance* (eidos), and *as* a mode of this kind of being, looking explicitly at something thus encountered is possible." (Heidegger 1996: 57)

[11] A radical criticism of the Gibsonian framing of perception was presented e.g. by Richard L. Gregory (1974). He compared widely known conceptions of perception and deemed Gibson's ecological psychology to be the worst of them.

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