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Column Article

Role of Affordance in Perception: Decoding the Sensory Input

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Abstract

In past years, there has been slow progress in the application of Shannon's mathematical theory of communication to the information processing in the brain. One of the major hurdles has been the lack of a plausible neurobiological correlate that would decode sensory inputs. We note that deciphering the sensory inputs based on potential actions is a key component of perception. We propose that affordance, which is an environmental property, such as height, shape, weight, etc. that can allow opportunities for actions by the organism, is a potential code that would decode the sensory input. The connections between the dorsal and ventral streams would serve as the anatomical basis of decoding by affordance, leading to perception. Furthermore, the current proposal is consistent with Bayesian and generative Markovian models of active inference.

Ecological psychology pioneered by J.J. Gibson has a powerful influence on the research of perception. Ecological psychology is a non-representationalist approach that attempts to overcome dichotomy between agent and environment, action and perception [1]. Overcoming these dichotomies is the key concept of affordance [1]. Affordances are environmental properties, such as height, shape, weight, etc. that can allow opportunities for various actions in relation to the mobility of the perceiver [1]. Moreover, the affordance is processed by the sensory system leading to perception, which may or may not be followed by an action.

For example, seeing a wall will result in a change of the course while walking inside a building. Retinal stimulation by the wall will result in the synchronous activation of photoreceptors by thousands of separate points or light sources on the wall. This will result in the temporal coupling of retinal pathways in the primary visual cortex, which will contribute to the knowledge in the neural circuits about the environmental properties of the wall, for example, its height [2]. Visual sensory information is further processed for perception by the ventral stream and for action by the dorsal stream [3]. Extensive connections between the dorsal and ventral streams [3] would serve as the anatomical basis for perception to guide the action.

There has been very little advance in the application of Shannon's mathematical theory of communication, which includes a sender, receiver and a common code used by sender and receiver [1,4], to the information processing in the brain. To some extent, this is due to the lack of explanation for plausible neurobiological correlates or code that would decode sensory inputs leading to perception. We propose that affordance is a potential code that would decode the sensory input, resulting in perception. The connections between the dorsal and ventral streams [3] would serve as the basis of decoding by affordance, leading to perception. The correlations, resulting from extensive connections between dorsal and ventral streams, will add to the knowledge about the environmental properties of external object, such as shape or height of the visual object, which will contribute to its perception. For example, the perception of the wall in the above example involves the awareness of the knowledge that it is a tall barrier that cannot be crossed. Thus, the perception of the wall will partly result from the knowledge of the action, that is, changing the course while walking due to its tall height. Furthermore, the role of affordance as a code for decoding sensory input concurs with the passivity of perception. Additionally, using Bayesian and generative Markovian model of active inference, it is argued that behavior emerges when action and perceptual inference maximize the sensory evidence [5,6]. According to this perspective, action fulfills the predictions based on inferred states of the world. We suggest that variational free energy minimization principle [6], which is consistent with this perspective, could be an important tool to study the code represented in opportunities for action for decoding sensory input.

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