

The theory of direct perception

A very very brief introduction to the
ideas of J.J. Gibson

Invariances, Affordances,

and

their significance for robotics

Why Direct Perception?

Below are just my personal opinions.

- It has a relevance for biologically-inspired robotics
- Robotics practitioners usually do not know/read Gibson's work;
- Those that know Gibson mention his work without really understanding it (see A. del Pobil, IRIDIA seminar, 19 Oct.);
- Those that do not know him, may end up saying exactly the same things pretending to be original (guess who is she/he?);

Biologically-inspired robotics

Engineering domain:

- Stygmergic communication
- Decentralised control and use of local information
- Robustness to failure
- Etc.

e.g., Marco is used to introduce the work of the SWARM-BOTS project in this way.

Cognitive sciences

- How the use of symbolic reasoning and representations emerge from simpler organisms (phylogeny and/or ontogeny).
- Homeostasis and feedback
- Species-specific \leftrightarrow general mechanisms
- Embodiedness
- Situatedness
- Etc.

Historical perspective

from

Sensation → Perception → Reasoning → Action

and general mechanisms

common to Behaviorism and Cognitivism

to

Action → Perception → Action

and ecological perspective

Heidegger, Merleau-Ponty, Gibson, Cyberneticists, etc.

General, universal, even worst
global: I am against, better
ANTI-

A metaphor

	Economics (2005)	Psychology (1950, 1990)
Majority	Globalists	Behaviorists - Cognitivists
Minority	ANTI-	ANTI-

Theory of Direct Perception

J.J. Gibson (1904--1979)

- “... senses can obtain information about objects in the world without the intervention of an intellectual process. ...”

No need of cognition, logic symbols, representations
- “... The perceptual systems, including the nerve centers at various level up to the brain, are ways of seeking and extracting information about the environment from the flow of ambient energy ...”

Need of action → perceptually guided action

The physical world, sources of stimulation

- “... In effect, aspects of the shape and texture of the object are projected outward from it in all directions. Herein lies the truth of the figurative assertion that aspects of an object are “broadcast”. ... A reflecting body can be said to radiate structure or information by virtue of the reverbering flux of reflected light in a medium. ...”

Information in the ecological world, stimuli

- “... Sources of stimulation are objects, events, surfaces, places, substances, pictures, and other animals. ...”
- Stimuli are patterns and transformation of energy at receptors. A stimulus may specify its sources, but it is not the same thing as its source. ...”
- “... a field of reflected illumination around an object, a field of air vibration from an event, a field of chemical diffusion from a substance, carry stimulus information. But whether the stimulus is effective or not depends on the presence of an observer, his receptive equipment, and its acts of looking, listening, or sniffing. ...” (pick up of information)
- page 39, “The characteristics of a natural stimulus”

Pick up of information

- “... The classic concept of a sense organ is of a passive receiver, and it is called receptor. But the eyes, ears, nose, mouth, and skin are in fact mobile, exploratory, orienting. Their input to the nervous system will normally have a component produced by their own activity. ... The eye is a self-focusing self-setting, and self-orienting camera whose image becomes optimal because the system compensates for blur, for extremes of illumination, and for being aimed at something uninteresting. This fact might seem to complicate hopelessly an understanding of how the senses work, but the intermixture of externally-produced and activity produced stimulation (invariances) promises to be the clue to an understanding of how the perceptual system work. ...”

Invariances

- Invariants are facts about the physical world encoded in the stimulus information that impinges on an organism's sensors.
- Invariants are automatically picked up (this imply activity, motion) and consumed by the organism.
- See page 162, “Guiding locomotion”

Affordances

An affordance is a property of an object, or a feature of the immediate environment, that indicates how to interface with that object or feature. The empty space within an open doorway, for instance, affords movement across that threshold. A couch affords the possibility of sitting down on it.

Gibson meant affordance to refer to all "action possibilities" that are dependent on the capabilities of the actor. For instance, a set of steps with risers four feet high does not afford the act of climbing, if the actor is a crawling infant. So affordances must be measured along with the relevant actors.

Affordances are aspect of the environment that afford the possibility of various activities for the animal, such as walking on, climbing up on, going through or into, chasing or fleeing from (predator, prey), etc.

R. Millikan

philosopher, not easy readings

<http://vm.uconn.edu/~wwwphil/millikan.htm>

- According to J.J. Gibson and contemporary ecological psychologist basic perception consists in “picking up” or extracting certain abstract patters in the ambient energies arriving at the organism’s sensory surfaces, which patters then guide various activities of the organism directly. No inference or calculation is required, but merely sensitivity to certain variants or invariants in the energies impinging on the active organism that, on the one hand, carry information about the relations of significant distal affairs to it, and on the other, directly guide its motions to take account or to make sense of distal affairs. Basic perception is thus interpreted as perception of what Gibson called “affordances”.

Ecology, watch out for where you look for generality

- “... Visual systems presumably developed in order to take advantage of information in ambient light. ...”
- “... Different species of animals get somewhat different types of ambient information and sample it in different ways. ...”
- “... The evolution of the retina accompanied the evolution of the eye and the nervous system, each depending on the other. ...”
- In general, eyes developed in accordance with the uses to which they might be put. ...”
- Bach-y-Rita’s works
(<http://www.engr.wisc.edu/bme/research/>)
- See page 184, “Summary”

This is the beginning of the story

read Millikan, or Varela for a possible follow up

- Biologically-inspired robotics, and certainly evolutionary robotics, are contributing to push further the Gibson's intuitions in order to fully understand how an observer, animal or human, can obtain constant perception in everyday life on the basis of these continually changing sensation (Who am I, in this continuous changing world).

In the new spirit of IRIDIA
meeting, I declare that:

- I appreciate the new style of the meeting
- I'm astonished by the Campo's punctuality, did he change your diet, or has he been threaten?
- Finally, I thank the organisers for their efforts

Cheers,