Affordances, Actionability, and Simulation

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Abstract— The notion of affordances depends crucially on the actions available to an agent in context. When we add the expected utility of these actions in context, the result has been called **actionability**. There is increasing evidence that AI and Cognitive Science would benefit from shifting from a focus on abstract "truth" to treating actionability as the core issue for agents. Actionability also somewhat changes the traditional concerns of affordances to suggest a greater emphasis on active perception. An agent should also **simulate** (compute) the likely consequences of actions by itself or other agents. In a social situation, **communication** and language are important affordances.

Keywords; affordances, actionability, active pereption, expected utility, language, simulation, volition,

I. INTRODUCTION

The notion of affordances depends crucially on the actions available to an agent in context. If we add the expected utility of these actions in context the result has been called "actionability". For this Workshop, we propose to have a guided discussion of the 21 points outlined below. For convenience, we are including references with each outline point.

Discussion Outline
Affordances, Actionability and Simulation

1) Action is evolutionarily much older than symbolic thought, belief, etc.; also developmentally earlier.

2) Only living things act (in our sense); natural forces, mechanisms act by metaphorical extension.
    Lakoff, G. & Johnson, M., Metaphors We Live By (1980) University of Chicago Press.

3) Fitness is nature's assessment of actions; we define **actionability** as an organism's internal assessment of its available actions in context.
    Observational learning without a model is influenced by the observer's possibility to act: C. Iani, S. Rubichi, L. Ferraro, R. Nicoletti, V. Gallese Cognition 01/2013; 128(1):26-34.
    The "genetic leash" labels how evolutionary fitness constrains (cultural) variation.

4a) Actionability, not non-tautological truth, is what an agent/animal can actually compute.
 We have no privileged access to external truth or to our own internal state.
4b) The **operationality** of all living things. Living things incorporate structures that model the external and internal milieus to enhance fitness.
In science, operationalism states that theories should be evaluated for their explanatory and predictive power, not as assertions of the reality of their terms, e.g. electrons.

5) Communication is action and is needed for cooperation – from pheromones to language.

6) Actions include persistent change of internal state: learning, memory, world models, self-concept, etc.
    *The external world (e.g., other agents) is not static - internal models need s**imulation**.*
Pfeiffer, B.E . & Foster, D.J. Hippocampal place-cell sequences depict future paths to remembered goals.   Nature, 2013; DOI: 10.1038/nature12112
    Both actionability assessment and simulation rely on good (not veridical) internal models.

7) The brain is not a set of areas that represent things, rather a network of circuits that do things.
    Confound: Neuroscientists sometimes use "representation" for any neural encoding.

8) In animals, perception is best-fit, active, and **utility/affordance** based.

9) Mysteries remain; subjective experience, binding, self, free will, robots, etc.
*Chalmers, D.J., The Conscious Mind: In Search of a Fundamental Theory. (1996) Oxford U. Press
"Science modulo qualia" ~ Carry on while acknowledging unapproachable issues.*

10) One crucial divide/cline is **volitional** action and communication – boundary not clear, but birds are above the line; protozoans, plants below. Assume, in nature, neurons are necessary for volition.
Damasio, A.R., The Feeling of What Happens (1999) Harcourt Brace

11) Volitional actions have automatic components and influence, e.g., speech.
  Deciding to talk is volitional; the details of articulation are automatic.

12) Cognitive Science is bounded by [neurons, individuals]; unify with related sciences.
  This is the common assumption; language, etc. involve related sciences.

13) Overall goal of the effort is consistency with all experimental findings.
  Newell, A. (1994). Unified Theories of Cognition, Harvard University Press

14) Theory remains central; multiple formalisms are needed – theories should cohere
  Control, probability, computation, logic, dynamics, utility, process, system, learning, etc.

15) Formulation is multi-level in three ways:
a) Standard divisions by scale, complexity - synapse, neuron, circuit, etc.
b) System formulation – whole and parts inseparable, body-environment coupling essential
c) Higher level sciences describe the phenomena, e.g., linguistics, psychology.
  Noble, D., The Music of Life (2006) Oxford U. Press

16) Action models are multi-modal: describe execution, recognition, planning, language.
  Generative Models ~ mirror circuits, Petri Nets
  Narayanan, S. (1999), Reasoning About Actions in Narrative, IJCAI '99, pp. 350-358,

17) Volitional simulation proposed as the mechanism of planning, mind-reading, etc. With an appropriate formalism, simulation can yield both causal and predictive inferences. Results of simulations can be cached (remembered) and generalized as rules.
  Pearl, J. , Causality: Models, Reasoning and Inference, (2000) Cambridge U. Press.
  Donoso,M.,A.Collins and E. Koechli(2014), Foundations of human reasoning in prefrontal cortex. Science, v.344, pp1481-1486.

18) Biological, social, and cultural co-evolution, including language.
  Richerson, P. J. and R. Boyd. (2005). Not By Genes Alone: How Culture Transformed Human Evolution, U. Chicago Press.

19) Linguistics based on embodied simulation semantics as the foundation of language and thought.
  Bergen, B. Louder than Words, (2013) Basic Books

20) Additional mechanisms include construction grammar, mental spaces, mappings, etc.
  Feldman, J. From Molecule to Metaphor, a Neural Theory of Language (2005), MIT Press

21) Rationalization and other mental illusions
  Kahneman, D. , Thinking Fast and Slow (2011) Farrar, Straus, Giroux