

The Real-Time Control of Action

COGS 200

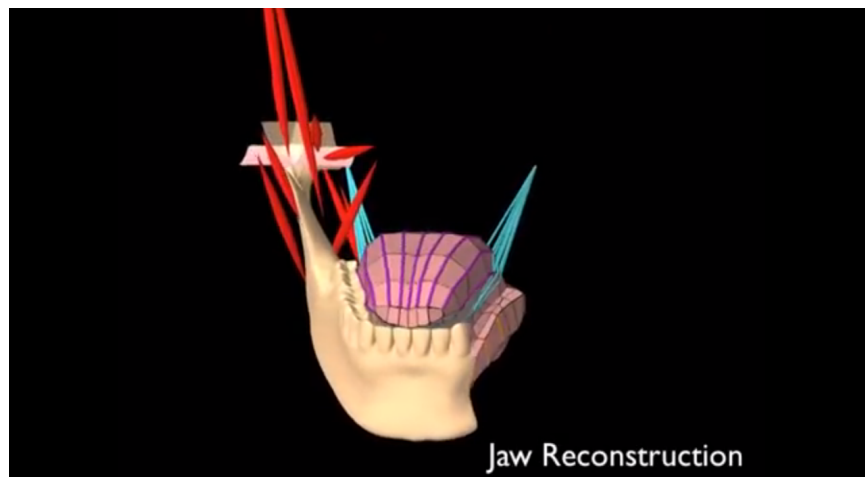
Concepts for Today

- Entrainment
- Affordance
- Passive Dynamics
- Intelligence without representation
- The Degrees of Freedom Problem
- What the motor cortex does
- Gibson
- Heidegger

Ball-catching

- Heuristic Solution: Run so that the angle of gaze increases at a decreasing rate.
- A system that exploits this solution behaves as if it had solved a set of differential equations....
- ...But nothing in the network looks like a representation of those equations.

The Degrees of Freedom Problem



The Degrees of Freedom Problem

- It's natural to think of each set of effectors as adding a dimension to action space.
- That creates a combinatorial explosion of possible trajectories through action space.

Coordination Without Control

- Sometimes, control can be dispensed with entirely.

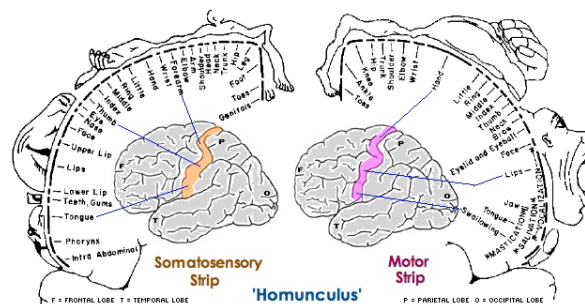


“Intelligence without Representation”

Rodney Brooks (1991):

“When we examine very simple level intelligence we find that explicit representations and models of the world simply get in the way. It turns out to be better to use the world as its own model.

Representation is the wrong unit of abstraction in building the bulkiest parts of intelligent systems.”

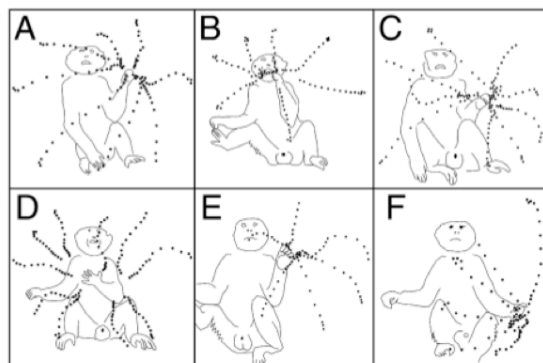


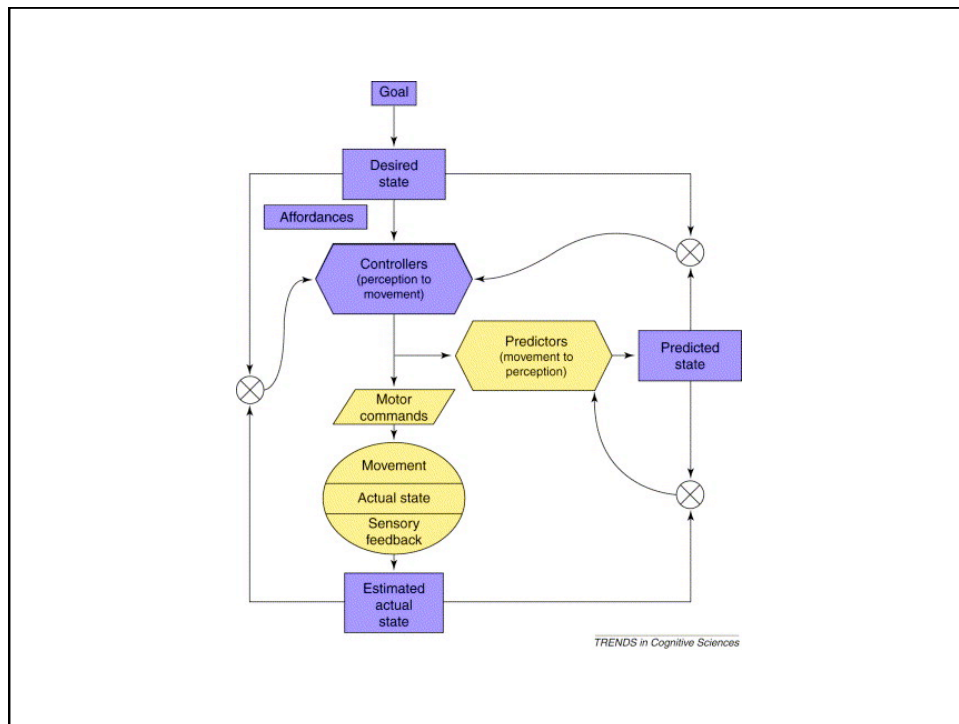
“The central nervous system knows nothing about muscles, it only knows movements.”

J. Hughlings Jackson (1889, p. 358)

Graziano, Taylor, And Moore (2002)

Non-punctate
microstimulation of
'motor strip'
produces
stereotyped pose...
...even when
different motions are
required to adopt the
pose.





'Predictive Brains'

“Prediction and error-correction cycles occur concurrently throughout the hierarchy, so top-down information influences lower-level estimates, and bottom-up information influences higher-level estimates of the input signal” Rao and Ballard (1999) p.80, cited in Clark, 2012.

Entrainment of Oscillators

Complex patterned behaviour without a representation of the complex pattern.



Christiaan Huygens

Being and Time

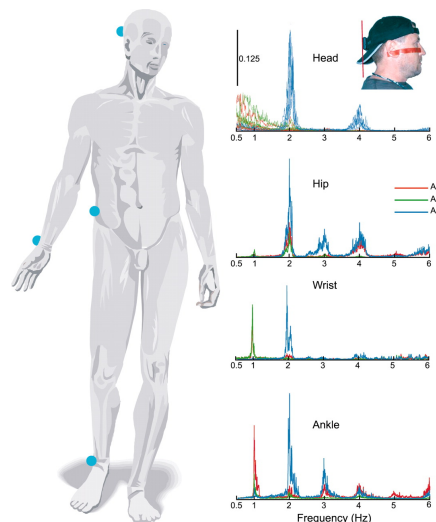
“Here we find a peculiar union of being in the world with the being of Dasein which itself can be made comprehensible only insofar as that which here stands in this union, Dasein itself with its world, has been made clear in its basic structures.”

(Heidegger 1925, Quoted by Dreyfus, *op cit.* p 99)

“Dasein, in so far as it is, has always submitted itself already to a ‘world’ which it encounters, and this submission belongs essentially to its being.”

(Heidegger 1927, quoted by Dreyfus, 1999, p. 159),

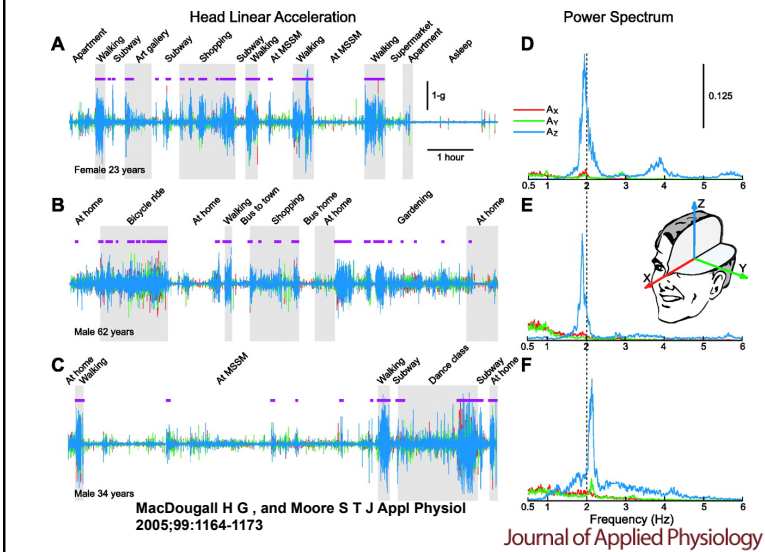
Power spectra of linear acceleration from a subject wearing the activity monitor on the head (data from 5 separate days are overlaid), wrist, hip, and ankle.



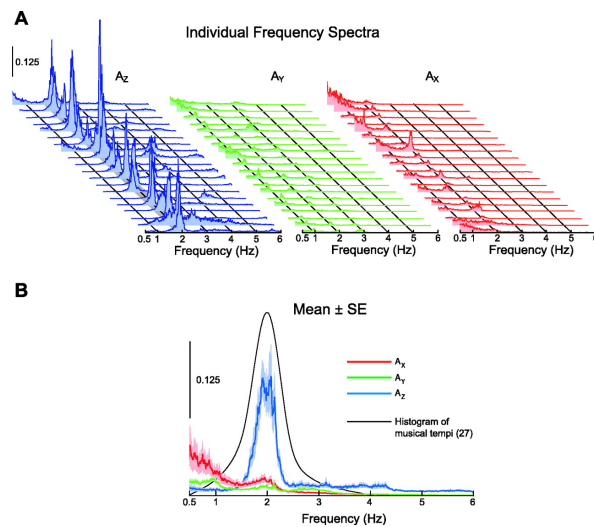
MacDougall H G , and Moore S T J Appl Physiol
2005;99:1164-1173

Journal of Applied Physiology

Linear acceleration of the head over a 10-h period for 3 subjects.



A: power spectra of linear acceleration of the head over a 10-h period.



Gibson's Ecological Approach to Perception

- Perception is not the achievement of an internal representation.
- Perception is an interaction between organism and environment ...
- ...insofar as it involves representations, the things represented are *affordances*.

Concepts from Today

- Entrainment
- Affordance
- Passive Dynamics
- Intelligence without representation
- The Degrees of Freedom Problem
- What the motor cortex does
- Gibson
- Heidegger