Welcome to

PHENOMENOLOGY ● COGNITION ● COMPUTATION

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Welcome to the 5th Workshop
Embodied Cognition

History 2014:

1.	COGNITION	January	DONE
2.	COMPUTATION	February	DONE
3.	PHENOMENOLOGY	March	DONE
4.	MIND & LANGUAGE	May	DONE

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Welcome to the 5th Workshop
Embodied Cognition

Program for 2014/2015:

5. Situated Cognition 25. October 2014
   Embodiment, Enactivism, Embedded Cognition/ Mind, Extended Mind

6. PCC - Selfdefinition November/ December 2014 ?
   Talking about questions that interest all of us and the PhenCoCo proposals

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Today´s Pogram

1. Website: www.phencoco.net
   PhenCoCo e-mail adresses:
   PhenDocu: Audiofiles are almost ready…

2. Embodied Cognition Lecture: See lecture slides

3. Discussion

4. Taking Stock/ Planning: DG Phil
   Mind The Brain
   Co-operations
   Funding

5th Workshop
Embodied Cognition

LECTURE: Embodied cognition. A New Paradigm of Cognitive Science?

Part I: Standard Cognitive Science and the Embodied Challenge
Part II: Characterizing Embodied Cognition

SPEAKER: Gonzalo Rojas

MATERIALS
(texts, blackboard pics, audiofiles, presentation slides)

WILL BE AVAILABLE
AFTER WE ARE CLEAR ON COPYRIGHT ISSUES

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Embodied Cognition

Main Sources:

- Shapiro, Lawrence. "Embodied Cognition." In: E. Margolis, R. Samuels, and Stich (eds.) Oxford Handbook of Philosophy and Cognitive Science. Oxford: Oxford University Press.
- Clark, Andy. Being There. Putting Brain, Body and World Together Again. Cambridge: MIT Press
- Gallagher, Shaun. "Philosophical Antecedents of Situated Cognition." In: Robbins, P. and, Aydede, M. (eds.) Cambridge Handbook of Situated Cognition. Cambridge: Cambridge University Press.

Other Sources:

- Wilson, Robert A. and Foglia, Lucia, "Embodied Cognition", *The Stanford Encyclopedia of Philosophy* (Fall 2011 Edition), Edward N. Zalta (ed.), URL = <http://plato.stanford.edu/archives/fall2011/entries/embodied-cognition/>.

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The plan

Part I: Standard Cognitive Science and the Embodied Challenge

• Theoretical and methodological commitments in standard cognitive science
An example: computational theory of vision
A loose summary of standard cognitive science
Philosophical and experimental challenges to the traditional view

Part II: What is embodied cognition?

- The thesis
- The role of the body
- Supporting the thesis
- Criticizing the thesis

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Part I: Standard Cognitive Science and the Embodied Challenge

Introduction

- Standard Cognitive Science
  - Cognitive processes are computational (symbol-manipulating) processes
  - Patterns of symbols can be detected, recorded, transmitted, stored, copied
  - Mental objects (beliefs, memories, desires, etc.) are symbolic structures with representational content.
  - There are symbols and symbolic operations within the brain.
  - What makes a part of the brain a symbol?
    - symbols are independent of their physical realisation
      - focus on functional criteria:
        - Symbols can "stand for" or represent things (representational function)
        - Symbols can be combined with other symbols according to rules. From this combinations new symbols result.

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Part I: Standard Cognitive Science and the Embodied Challenge
Standard Cognitive Science

- Combinatorial properties of some symbols are important for standard cognitive science:

  Language of thought hypothesis (Fodor, 1975): Thoughts are sentences in an internal language, and reasoning involves combining and manipulating the components of these sentences

- Traditional cognitive science relies on:
  - Representations acting as vehicles of contents (they are typically amodal)
  - Rules

  Symbol manipulation through inference: to derive conclusions that are beyond the information contained in the input stream

- Methodologically standard cognitive science relies on a solipsistic perspective: experiments are conducted in controlled laboratory settings and the subjects receive inputs passively.

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Part I: Standard Cognitive Science and the Embodied Challenge
Standard Cognitive Science

- An example: computational theory of vision

  - Assumption:
    - Task of the vision is to construct 3-D representations of objects from 2-D representations on the retinal surface.
    - Retinal projections carry too little information about the objects that cause them
  - Perception requires inference
  - Thus, researchers need to find which algorithms can infer 3-D structures from 2-D representations
  - Method:
    - Since cognition begins with an input representation, the subject is in experiments passive and static.
    - Cognitivists search for algorithms which transform inputs in outputs

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Part I: Standard Cognitive Science and the Embodied Challenge
Standard Cognitive Science

- Experimental methods isolate stimuli that are relevant just for the researched mental process

- Goal is to understand which computations over which representations are necessary to perform a cognitive process
- Processes start when stimuli are encoded in representations
- Therefore, features of the body or environment are not considered
- Methodological solipsism:
  - Investigations focus on the brain, the place where all computations happen

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Part I: Standard Cognitive Science and the Embodied Challenge
Standard Cognitive Science

- In summary:
    - Cognition is computation
    - Computation operates over symbols
    - Symbols begin with inputs to the brain
    - Symbols end with outputs from the brain
    - Cognition takes place in the brain alone
    - Cognitive science must focus on the brain, which is some sort of inference machine

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Part I: Standard Cognitive Science and the Embodied Challenge
The Challenge

- Ideas that conflict with the cognitivist picture

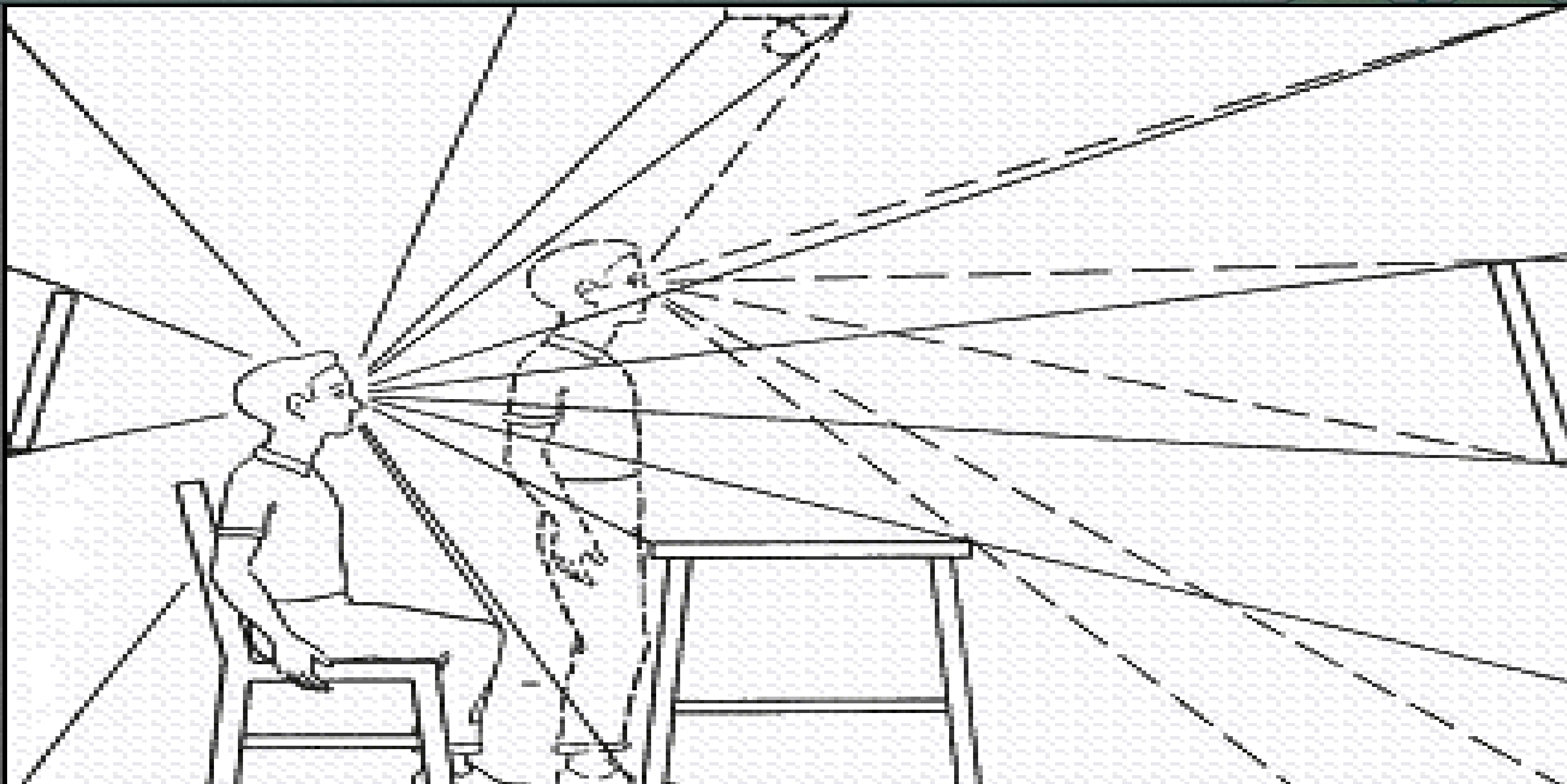
  - Phenomenological approaches in the early 20th century
  - Importance of situatedness and embodiment of mental processes:
    - Husserl‘s Leib/Körper distinction
    - Heidegger‘s in-der-Welt-sein
    - Merleau-Ponty‘s idea of perception as a form of action
    - The body supports the very possibility of experience

  - School of ecological psychology
  - Connectionist networks

Part I: Standard Cognitive Science and the Embodied Challenge
The Challenge

- Example: Gibson‘s studies on visual perception
  - Optic array: information contained in the environment as light reflected from surrounding surfaces (shapes, textures, colors)
  - Differences in the wavelenght intensity from one surface to another
  - This causes a projection onto the organism‘s sense organs: a group of visual angles
  - The edges of these angles are the boundaries of surfaces in the environment
  - If the organism moves, the elements of the optic array change in a lawform way: expansions and contractions of the angles
  - In this changing patterns there are a variety of constant features

Part I: Standard Cognitive Science and the Embodied Challenge
The Challenge



Part I: Standard Cognitive Science and the Embodied Challenge
The Challenge

- The invariant features carry information about structure in the environment
  - Example: objects with equal size at different distances will be cut by the horizon in the same proportion
- Perception is coupled with action: invariants appear when the point of observation changes (perceivers move within the environment)
- No need for computations over representations to determine object size
- Object size is already specified by invariants (like horizon-cuts) in the optic array

- These ideas are the base for a theory of affordances:
  - The information in the optic array suffices to specify opportunities for action
  - This information provides observers with the ability to perceive objects in virtue of the actions they allow
  - Different organisms will perceive different affordances: the fact that an object can be sat upon (affords sitting) depends on the bodily constitution of the observer and the features of the object

Part II: What is embodied cognition?
The thesis

- “Many features of cognition are embodied in that they are deeply dependent upon characteristics of the physical body of an agent, such that the agent’s beyond-the-brain body plays a significant causal role, or a physically constitutive role, in that agent’s cognitive processing” (Wilson & Foglia, 2011).

- What does it mean that cognition is embodied?
- Which role plays the body in cognitive processes?
- Is this thesis compatible with standard cognitivism?
- If it is not, can embodied cognition replace standard cognitivism as a better theory?

Part II: What is embodied cognition?
Views of embodiment
Does the body limit an organism‘s conception of the world?

- Metaphor and Cognition
  - Lakoff and Johnson (1980)
  - The body constrains an organism’s conceptualization of the world
  - Human experience is intimately connected with metaphors
  - Experience and metaphors are shaped by the kind of bodies we have
  - Thus, different organisms with different bodies have different conceptualizations of the world

- Enactive Cognition
  - Varela, Thomson, Rosch (1991)
  - Against cognition as problem solving based on representations
  - An organism’s conception of the world is a function of its history (ontogenetic and phylogenetic) of interactions with properties in its environment
  - Bodily properties of an organism determine form of these interactions
  - Thus, organism with relevantly different bodies conceive the world differently

Part II: What is embodied cognition?
Is the body a constituent in cognitive processes?

- Two hypotheses:
  - A) The body is literally part of the mind
  - B) The mind extends beyond the body, into the world (extended cognition)
  - Problem: distinction constituents of the mind/causal influences of the mind

- A theory: perceptual experience (O'Regan & Noë 2001)
  - Rejection of computational approaches to vision
  - Focus on importance of action in perception
  - Constituents of perception are extended into the bodies of the perceivers
  - Visual experience depends on the particular features of the visual system and the particular features of the world to which this system is sensitive
  - Thus, a visual system x, when exposed to features y, will behave in a regular way that can be lawfully described
  - These regularities define sensorimotor contingencies unique to each sensory system
  - Example: concave retina can detect shape (but not sound or odor)
  - As the eyes (or the perceiver) move or as shapes move about a perceiver, the interactions will obey various regularities

Part II: What is embodied cognition?
Is the body a constituent in cognitive processes?

- These are *sensory* (depend on visual aparatus and features of the world) and *motor* (depend on the activities of muscles in the body) contingencies
- Example: the way a shape (a line) transforms when projected on a concave retina
    - When at the center of the eye's focus, the line produces an arc on the retina
    - When the focus is shifted from the line to a point above the line, the curvature of the line on the retina changes

- "In seeing, specifying the brain state is not sufficient to determine the sensory experience, because we need to know how the visual apparatus and the environment are currently interacting. There can therefore be no one-to-one correspondence between visual experience and neural activations. Seeing is not constituted by activation of neural representations" (O'Regan & Noë, 2001: 966).

- Perception is not a process in the brain, but a bodily skill, a tacit knowledge of sensorimotor contingencies

Part II: What is embodied cognition?
Body-World Interactions. Do we need a new cognitive science?
Intelligence without representation

- Problems of implementation in traditional AI: robots based on sense-think-act architecture
- Rodney Brooks (1991) proposes a better architecture: subsumption
    - Layers which directly connect sensing with acting
    - Layers are defined in terms of the actions they perform (“avoid”, “visit distant object”)
    - Layers running in parallel assist each other:
        - The robot heads toward the distant object and avoids obstacles
        - The first layer changes the course and the second puts the robot back on track
    - Further additions of layers make the robot behave quite intelligently through a changing environment
    - The plasticity of the robot does not depend on a central processing unit, but emerges from a collection of competing behaviors
    - These robots do not represent features of the world, they only respond to these features. The world is its own model.

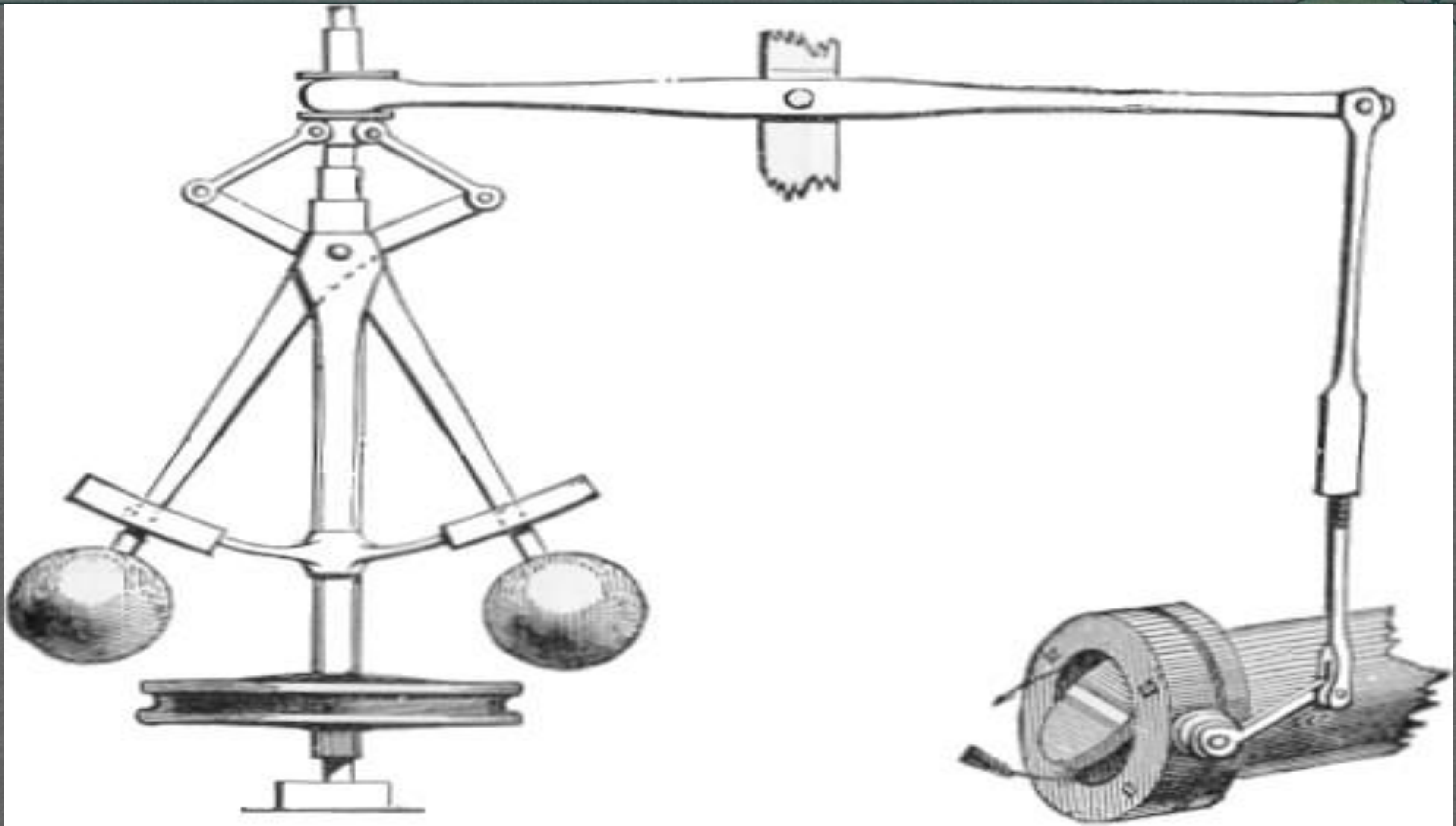
Part II: What is embodied cognition?
Body-World Interactions. Do we need a new cognitive science?
Cognition emerges from dynamical systems

- Thesis: cognition emerges from dynamical systems (continuous interactions between organisms and environments)
- Computational theory of mind cannot account for certain features of cognition
- Dynamical system: any system whose changes of state over time can be modeled with a rule, which usually takes the form of a differential equation
- Example: oil heating in a frying pan (Kelso, 1995)
    - State 1: before being heated the molecules move randomly
    - State 2: at a critical temperature the surface begins to roll and the molecules move regularly
    - Temperature is here a control parameter (affects the state of the oil molecules)
    - The amplitude of the convection rolls on the surface is the order parameter (amplitude of the rolls is the product of the molecules which now display collective behavior or order)

Part II: What is embodied cognition?
Body-World Interactions. Do we need a new cognitive science?
Cognition emerges from dynamical systems

- Two interesting features of this example:
  - a) The pattern on the surface of the oil is emergent, or self-organizing
    - The control parameter does not contain a code for the emergent pattern: there are no instructions guiding the molecules toward the pattern
  - b) The pattern of causal events is cyclical:
    - The rolls are result of the behavior of individual molecules
    - The behavior of the molecules becomes a function of the rolls
    - The rolls are a higher order pattern that influences the lower order elements
    - The lower order elements (through their motion) maintain the higher order pattern
    - The elements of the system are coupled: the description of the behavior one part includes a term that describe the behavior of the other
- Can we understand cognition dynamically?
  - Van Gelder's dynamical Hypothesis (1998)

Watt's Centrifugal governor



Part II: What is embodied cognition?
Body-World Interactions. Do we need a new cognitive science?
Cognition emerges from dynamical systems

- Cyclical pattern of causation and coupling:
  - Speed of the flywheel, height of the flyballs and opening of the throttle valve are continuously dependent on each other
  - They are coupled: equations that describe the changes in state of any of them contain terms that represent the changes of the other two
  - The process cannot be conceived as a sequence of discrete steps (like algorithms do)
  - Timing is an essential feature: equations accommodate idea of simultaneous change

"The size of the opening of the throttle valve is changing *as* the height of the flyballs is changing *as* the speed of the flywheel is changing. There is no first, middle, and last –no sequence of events" (Shapiro, 2011: 123).

Part II: What is embodied cognition?
Body-World Interactions. Do we need a new cognitive science?
Cognition emerges from dynamical systems

- No representations needed in explanation
- In cognition there are no principled partitions between beginning, middle, and end
- The circle of causality involves the brain, the body, and the environment
- These elements are coupled and each component is itself a dynamical system

The Problems of embodied cognition
Preparing the debate

- Are embodied and standard cognitive science competing or complementary theories?
- If they are competing theories, which one should be dismissed?
- How strong is the support for the idea that the body constitutes a constrain for conceptualization?
- Is it plausible to dismiss the idea of mental representations?
- Do we have a principled definition of representations?
- Is it plausible to dismiss the idea of cognition as computation?
- Are dynamical explanations really explanations?
- Is the body a constituent of cognition?
- Can cognition be extended outside the body?

Part I: Standard Cognitive Science and the Embodied Challenge
The challenge

4 Mind & Language	Date:	May 2014
	Content:	Cognitive Psychology & Linguistic (Denis) Content: Neurolinguistics, Primates, PhilOLanguage, Davidson, Tomasello (Anna)
5 Situated Cognition	Date:	October 2014
	Content:	Embodiment, Enactivism, Embedded Cognition/ Mind, Extended Mind
6 PCC - Selfdefinition	Date:	November/ December 2014
	Content:	Talking about Questions that interest all of us and the PhenCoCo Proposals

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Goodbye!

Thank you for taking part,

if the presentations helped with your work, please let us know! (phencoco.net, or directly)

We hope you enjoyed the workshop.

See you next time

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