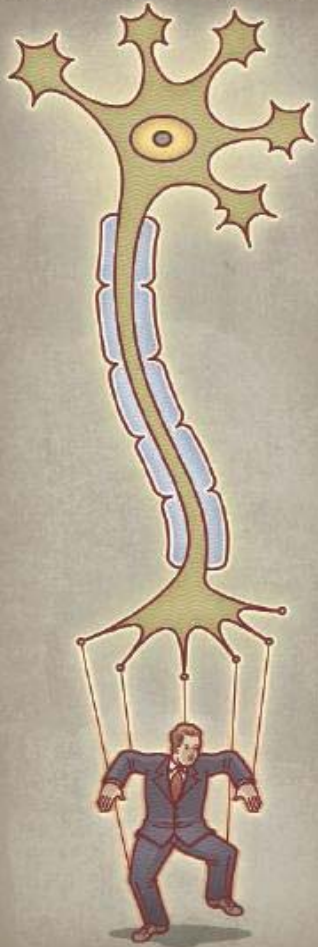


Integrating meanings and mechanisms: how cultural influences and neural mechanisms constrain each other.



Machiel Keestra, Institute for Interdisciplinary Studies,
Transdisciplinary-Net Conference, Bern, Nov. 21, '09
<http://home.medewerker.uva.nl/m.keestra>

Action & understanding as complex, multilevel functions

Commentary/Sirois et al.: PreCis of Neuroconstructivism

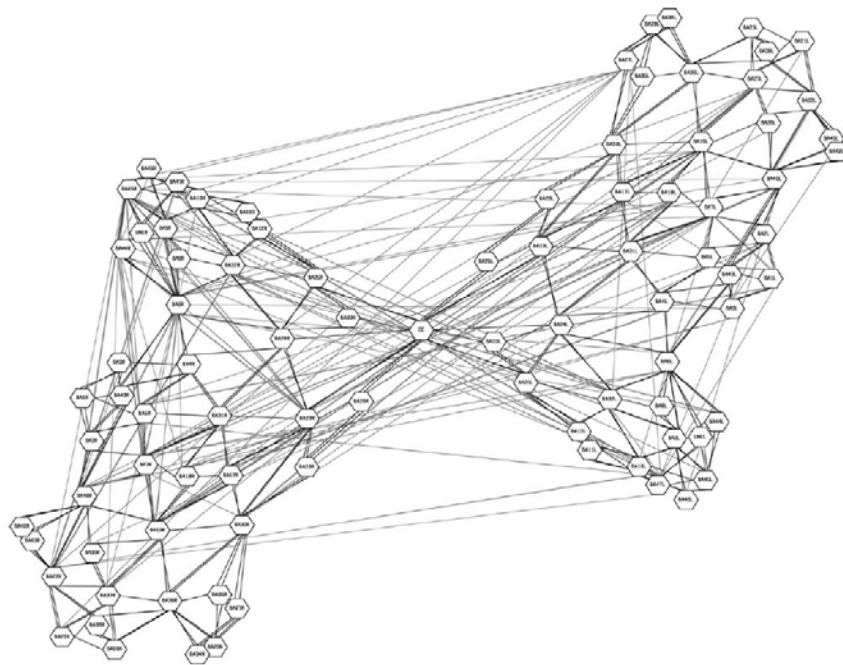


Figure 1 (Andriescu). Cortex represented as adjacency or co-activation graphs. Here the Brodmann areas are nodes, with black lines between adjacent areas and gray lines between areas showing significant coactivation. The graph on the left shows coactivations from 56 action tasks, and the graph on the right shows coactivations from 77 attention tasks. Graphs rendered with *atSea* v. 2.2.

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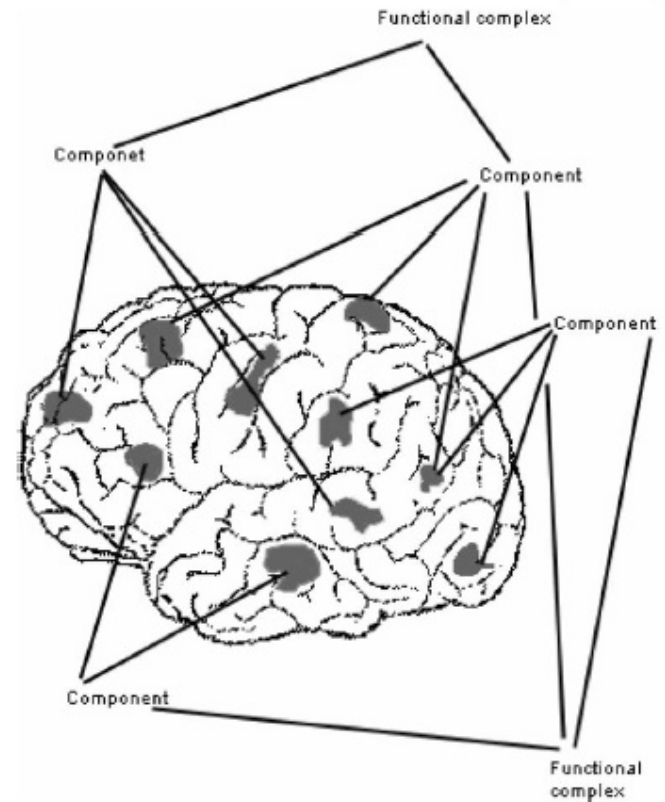
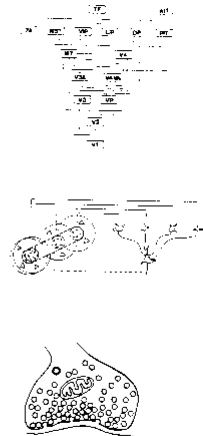
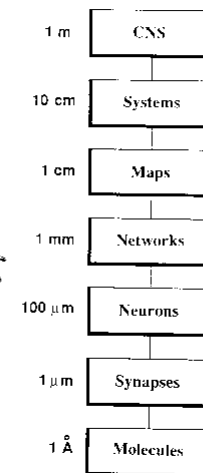
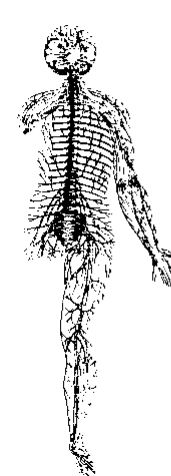


Figure 4. Anatomical illustration of 3-tier architecture, with many-to-many relationships between levels.

Theoretical pluralism in multi-level systems

- Relative significance of theories (restricted domain)
- Multi-level systems: various constraints on normal functioning stem from distinct levels
- Relative causal autonomy at each level
- Different kinds of interactions between levels
- Intervention techniques differ per level
- We need to go ‘beyond the skull’ and integrate hermeneutics in the mechanism



Mechanistic explanation of complex phenomena.

1. Decompose a phenomenon
2. Try to identify & localize components & possibly sub-(sub-)components
3. Integrate these into a multi-level mechanism
4. Differentiate intra-level & inter-level relations/activities
5. Study role-functions & constitutive relations
6. Re-compose the mechanism in light of new results

(Bechtel, 2006; Craver, 2007; e.a.)

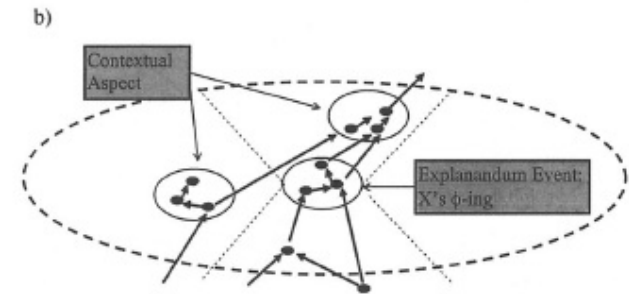


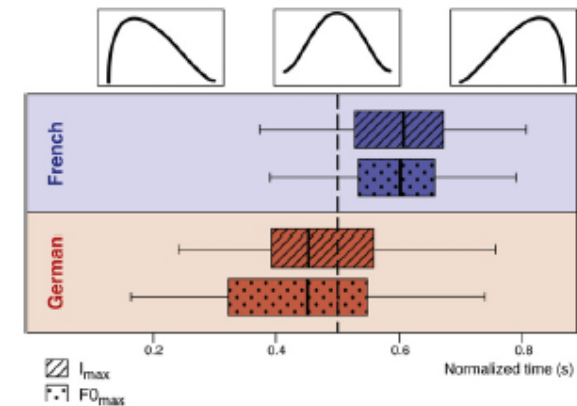
Figure 3. Constitutive, etiological, and contextual explanations. Figure 3(a) is modeled upon Salmon (1984, 275) and exhibits the etiological and constitutive aspects mechanistic explanation. Figure 3(b) superimposes the contextual aspect onto Salmon's diagram.

Generative entrenchment: ‘how the contingent becomes necessary’.

- Complex dynamic systems integrate new features in a pseudo-innate functional form
- Depending on those features, new functions are built
- Those functions evoke new interactions, etc.
- Example: feathers for flying
- Nota Bene: information can also become integrated!



(Herbert Simon 1969; William Wimsatt 1986)



Mental functions as multi-level systems

- Bio-molecular and neural levels are constitutive
- Contingent -environmental- information gets incorporated
- Such incorporation affects the constitution as a whole
- Ergo: mutual constraints between levels!



Human action understanding as a complex mechanism?

Two rivalling perspectives:

- Meaning of action requires involvement of socio-cultural and historical contexts
- Action is determined by neural and biological factors and requires bottom-up explanation

(compare simulation theory & theory theory)

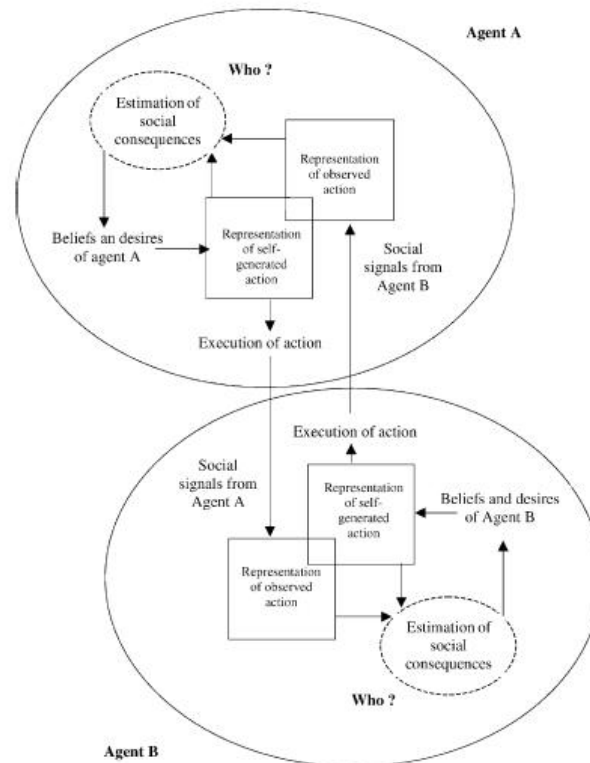


Fig. 8. Example of a frontward loose left hand cotimed with the word *antiguo* (“old”).

‘Shared representations’, mirror neurons: a neural basis of action understanding?

M. Jeannerod / Behavioural Brain Research 142 (2005) 1–15

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Hermeneutics and the understanding of action

- Gadamer on ‘fusion of horizons’ & dialogue
- Ricoeur on ‘mimesis’:
 - actions are **configurations**
 - understanding is a dynamical and reciprocal **process**
 - three **phases** can be distinguished:
 - 1) prior to understanding: prefiguration
 - 2) the presented content : configuration
 - 3) recursivity: transfiguration (cf. hermeneutic circle; Applikation)

Hermeneutical element in neural correlates of action understanding?

- Consider configuration issues in neural action coding or representation
- Consider processual aspect
- Consider reciprocity: action determination as itself involved in the hermeneutic process

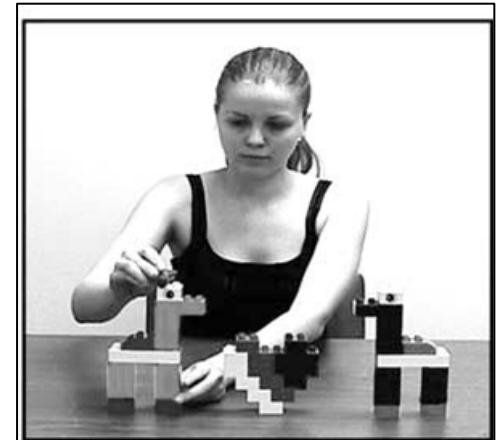
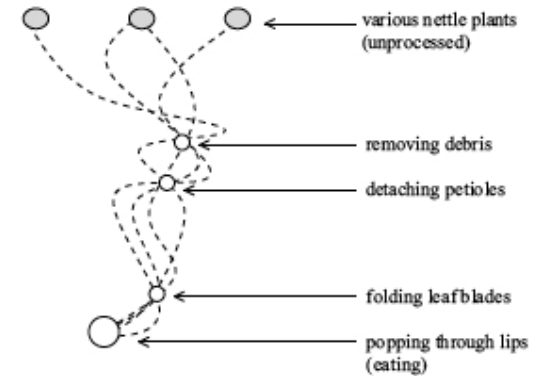
Neuroscientific evidence on hierarchical coding of action

Hierarchical coding enhances

- flexibility
- robustness
- adaptivity
- speed
- recognition
- learning

(cf. generative entrenchment!)

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Cultural and experiential information in action production & understanding

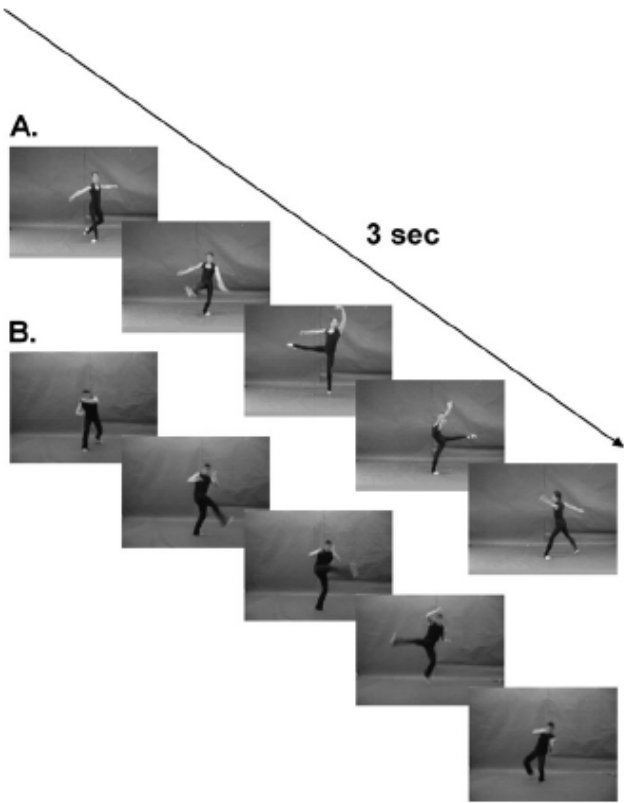


Figure 1. Stimuli: Colour videos of standard classical ballet and capoeira movements were performed by professional dancers. Twelve different moves of each style (a, ballet; b, capoeira) were matched by a professional choreographer for kinematic features (for examples see videos in the supplementary information online).

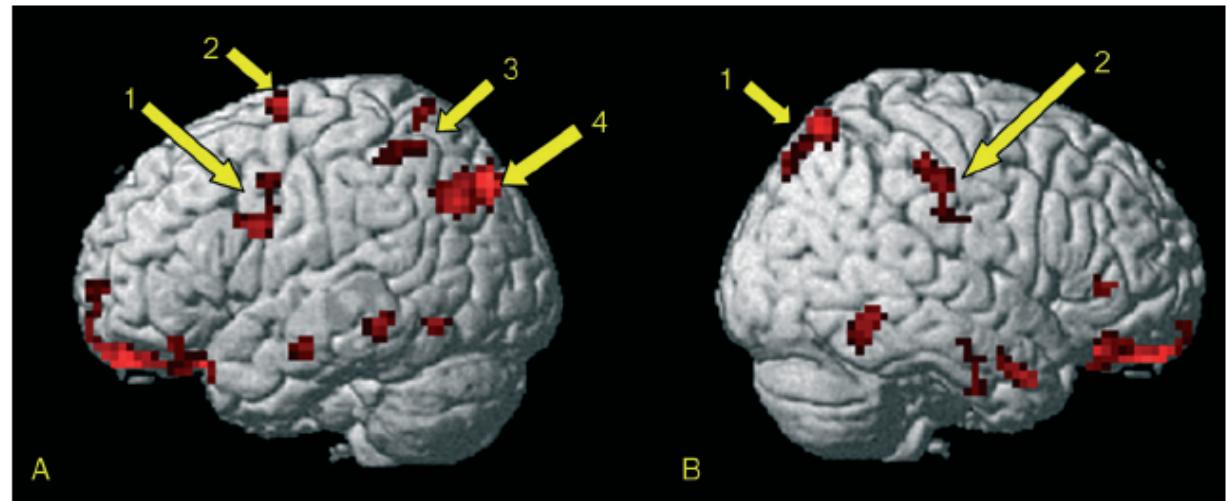


figure 2. Effects of motor expertise on brain responses to action observation defined as the group by condition interaction. Projections of the activation foci on the surface of standard brain (Montreal Neurological Institute, MNI). Note that this projection renders onto the surface activity which may in fact be located in the sulci. Activations significant at $P < 0.001$ uncorrected are shown in red. For display purposes, an extent threshold of 10 voxels has been used. Arrows indicate predicted areas with activations significant at $P < .05$ after small volume correction using a 10 mm sphere. These are in the left hemisphere system (A), in (1) ventral premotor, (2) dorsal premotor, (3) IPS and (4) pSTS. In the right hemisphere (B) we show activations in (1) SPL and (2) IPS.

Language as an additional coding system

Language is flexible and systematic at once:

- categorization
- hierarchy
- syntax
- semantic nets

Cf. Barsalou's symbol systems (1999; 2008)

(Not just modal/perceptual, but also amodal symbol system)

‘Sculpting the response space’

- Experience & language determines coding
- Hierarchical coding
- Language as a ‘simulator’ (Barsalou, 1999)
- Sculpting as an interactive, intersubjective process

Dynamical aspect of action understanding

Neuroscientific correlates of the hermeneutical aspect of dynamics and reciprocity?

Low-level adjustments of movement

Context sensitivity of action selection

'Action repair' during interaction

Action selection determined by intersubjectivity

Neural constraints on hermeneutics?

- Consequences of neural coding of action:
 - (in)compatibility aspects of ‘event codes’
 - specific aspects of neural hierarchy of action coding
- Experiential bias on action understanding
 - mirror neurons and their role as biases
- Generally: embodiment of action understanding

Desiderandum: mutually constraining mechanisms and meanings

- Hermeneutic constraints
- Contextual constraints
- Biological/physical constraints
- Neural constraints
- and their interactions



Thanks for your presence!

(m.keestra@uva.nl)