European Science Foundation
"Consciousness in natural and Cultural Context »

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The conscious experience of what is reachable:
neural, behavioural, cultural and philosophical aspects
(CEWR - 2006/2009)

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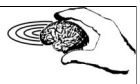


Project

The main objective of our (CEWR) CRP is to investigate the (perceptual, motor, cognitive and cultural) processes involved in the conscious experience of space in relation to action by analysing how individuals perceptually determine what is reachable, i.e. the limit of subjective peripersonal space for themselves and others, as well as the brain mechanisms underlying such spatial categorisation .

The CNCC European program offers the opportunity for a multi-disciplinary approach of this issue including different domains of research such as neurosciences, cognitive psychology and philosophy.

PHILOSOPHICAL CONSIDERATIONS

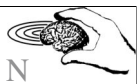
Role of Philosophy?

- Conceptual clarification.
- Raising empirically testable issues.
- Complementing behavioral and neuronal data with fine-grained experiential investigations.

Non-reductionist naturalistic approach

↳**Mutually constraining** integration of empirical and theoretical work

↳ **Mutually enriching** considerations of how the embodied subject shapes the experience of space.



C O N C E P T U A L C L A R I F I C A T I O N

Three levels of description/investigation of the body:
(Metzinger's first/second/third-order embodiment?)

- Functional

Bodily aptitudes?

- Representational

Representation of these bodily aptitudes?

- Experiential

Subjective experience of these bodily aptitudes?

What are the relevant levels of embodiment anchoring and structuring the experience of spatiality?

E X P E R I E N T I A L C L A R I F I C A T I O N

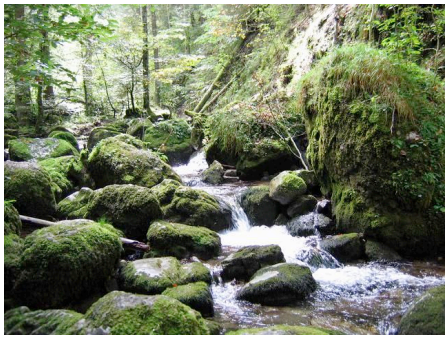
1. How is the body experienced?
   - Reflectively (as an explicit intentional *object*?)
   - Pre-Reflectively (as a perceiving and acting *subject*?)

2. How is space experienced?
   - Continuous? Structured?
   - Stable? Flexible?

3. How is the relation between body and space experienced?
   - bodily anchored space?
   - bodily structured space?
   - spatially anchored body?

→« First-person » methodologies allowing for fine-grained descriptions of subjective experiences.

Theoretical context



Conscious experience
of continuous external world

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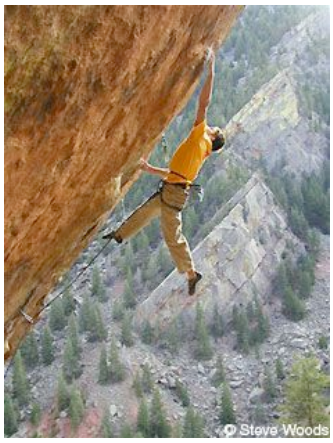
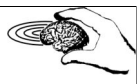


Conscious experience
of discontinuous action space

Experience of space **anchored** to and **structured** by the **embodied** subject

> The experience of space
> "announces a certain indissoluble link between things and myself by which I am placed in front of them"
>
> (Merleau-Ponty, 1945)

> We experience space insofar as we experience objects spatially, and we do so insofar as we relate these objects to our own perspective as perceiving subjects: Something is experienced as near or far, to the right or to the left only relatively to the subject's own location in space.



Aim of the project from an empirical perspective

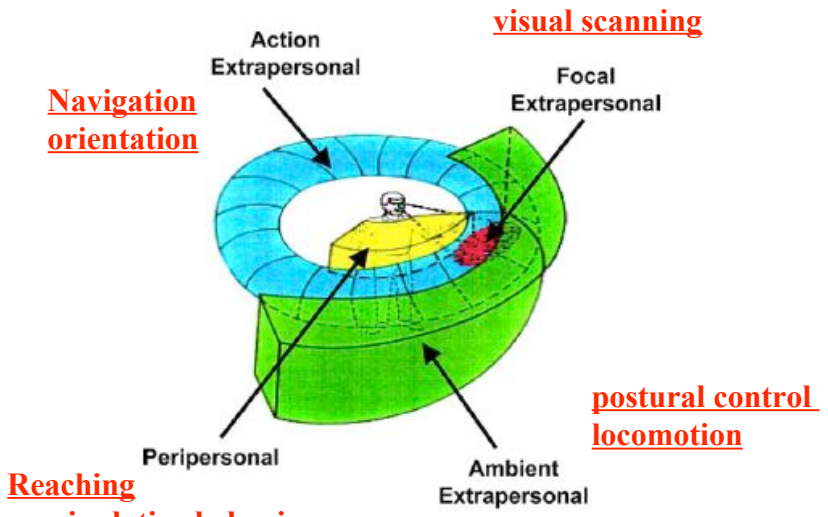
Main issue:

How the brain organises the perception of external space in relation to action, with a particular emphasis on how the limit between peripersonal and extrapersonal space is determined.

Necessity to distinguish peripersonal and extrapersonal space

Peripersonal space is defined as the space immediately surrounding our bodies. Objects within peripersonal space can be grasped and manipulated; objects located beyond this space (extrapersonal space) cannot normally be reached without moving toward them, or else their movement toward us. It makes sense, then, that the brain should represent objects situated in peripersonal space differently from those in extrapersonal space. (Previc 1990, 1998, Rizzolatti & Camarda 1987)

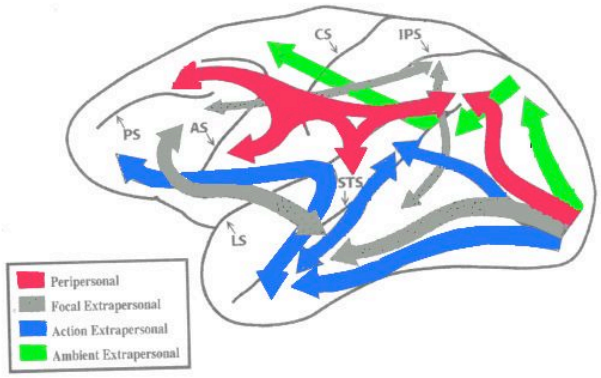
Naturalisation of CEWR



Previc (1990, 1998)

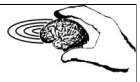
Neuroscientific attempts in the past to formalise the functional organisation of the perceptual function and the conscious experience of space and action space has conducted to discriminate 4 main sub-spaces.

The functional organisation of the brain



Macaque brain
(Previc, 1998)

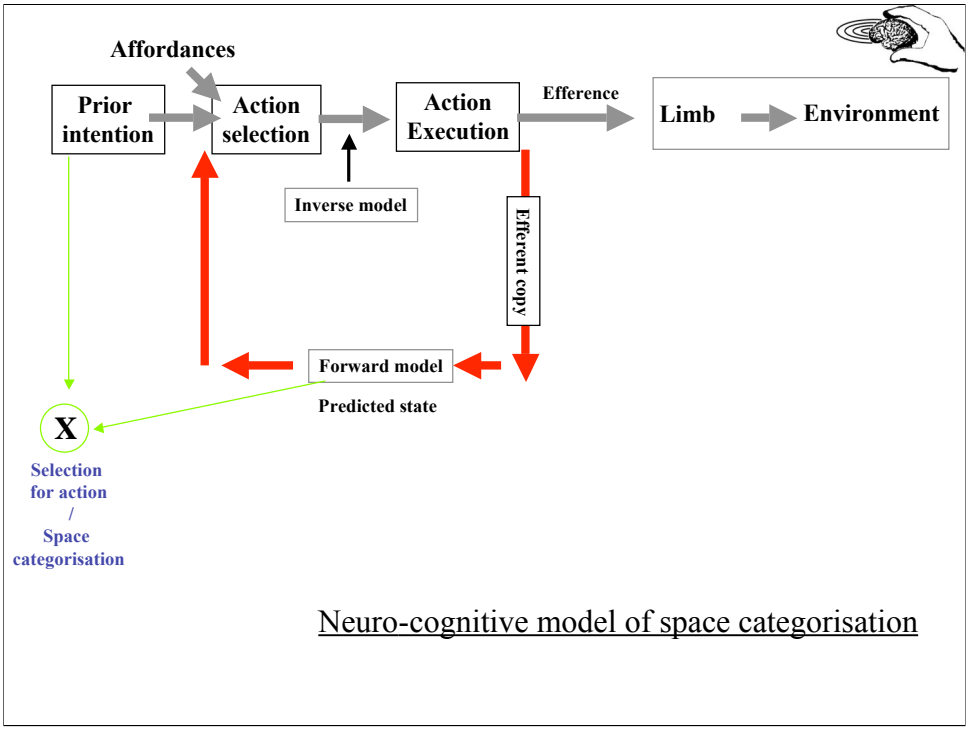
Interesting is the finding of a functional organisation of the brain: two dorsal streams for peripersonal and ambient extra personal spaces and two ventral steams for focal and action extra-personal spaces.



Aim of the project

Working hypothesis:

Space categorisation and conscious experience of what is reachable depends on implicit knowledge about body capabilities and anthropometric characteristics of the body in action.



Neuro-cognitive model of space categorisation

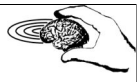
In this context, we use a neuro-cognitive model of space categorisation

According to this model, information related to motor activity has a very relevant contribution to spatial categorisation and CEWR, which has often been neglected in the past. The underlying neuro-cognitive model suggests that for a desired goal, the motor centres generate an appropriate outflow signal for producing a movement (inverse model). At the same time a motor command is sent to the effector, a copy of the command is sent to an internal predictive (forward) model.

By generating an efferent copy of the motor command, the motor system can simulate the motor execution and therefore can predict and anticipate the sensory consequences of self-generated movements.

The function of the simulation process would be not only to shape the motor system in anticipation to execution, but also to provide the self with information on the feasibility and the meaning of potential actions.

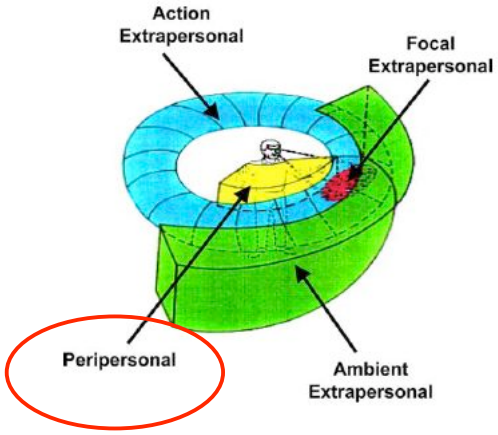
Aim of the project



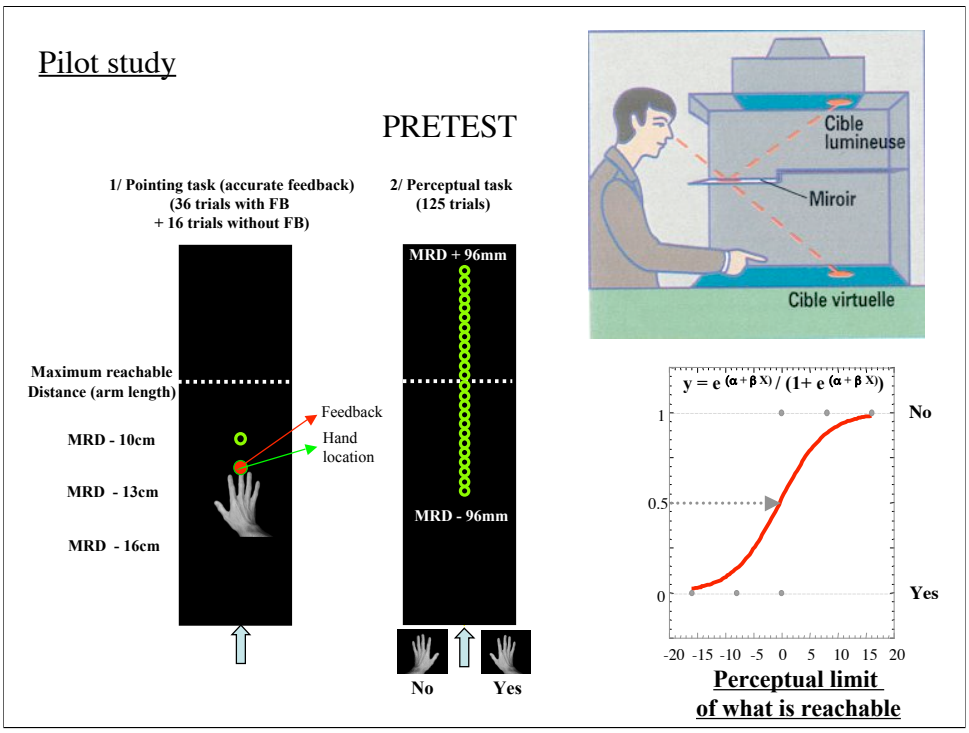
Research program:

Demonstrating that CEWR relies on information from the motor system, and that this information is used to categorise external space through simulated motor activity.

Focussing on peripersonal space …

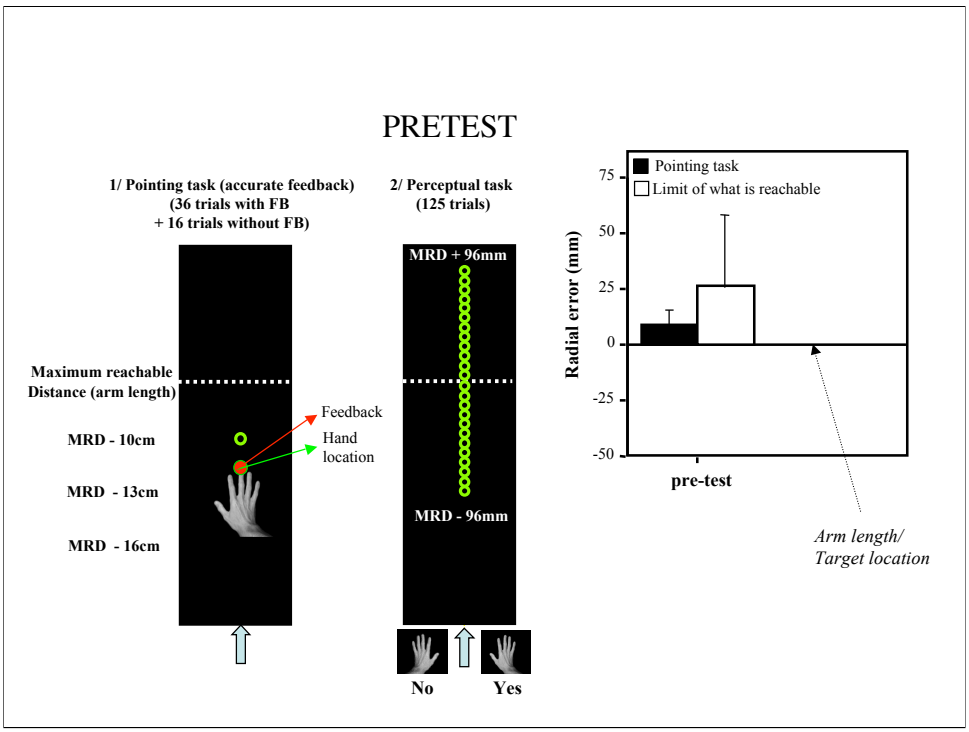


(from Previc, 1998).

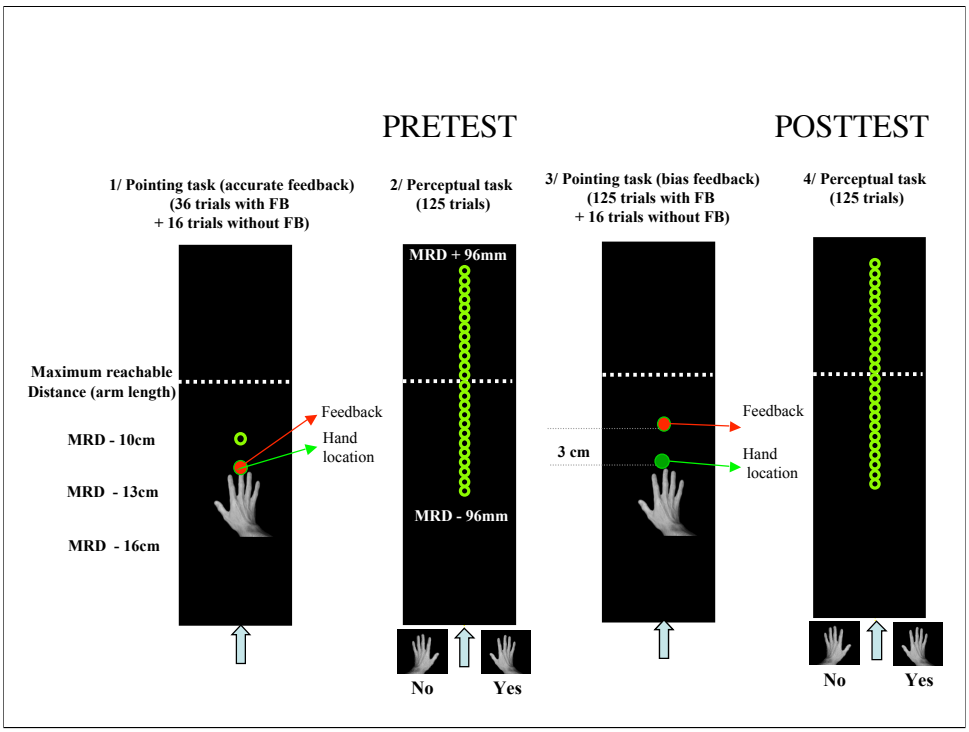


A pilot study that we carried out recently provided some evidence for the participation of the motor system in space categorisation and CEWR.

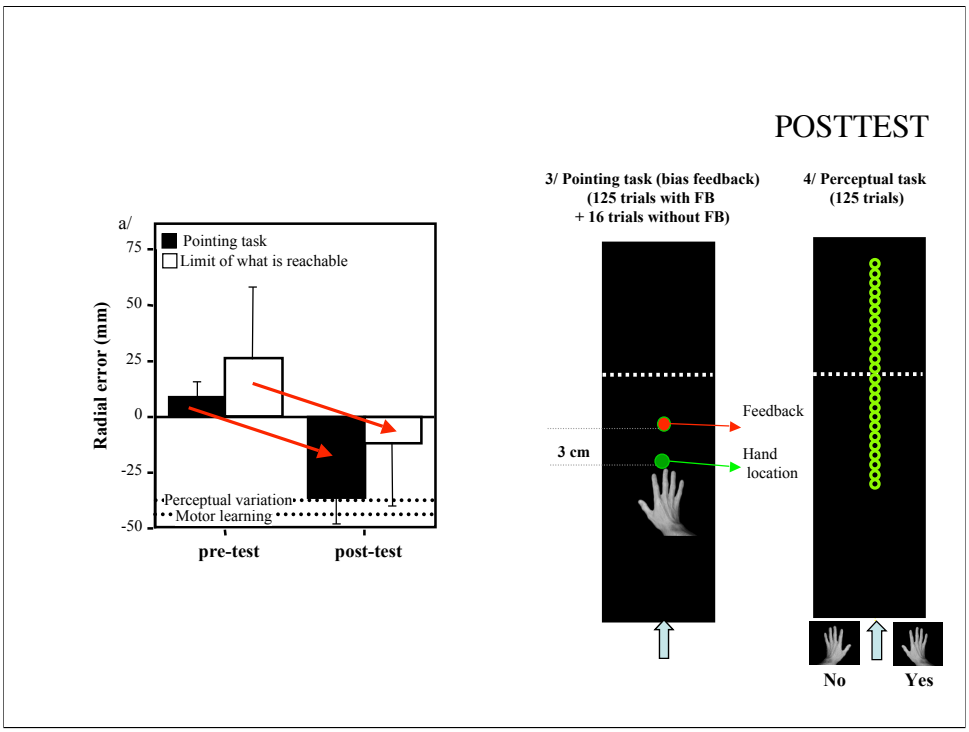
In this experiment, we asked adult participants to make a simple pointing task during which an accurate a posteriori visual feedback was provided consistently about the performance. In a second task, participants had to estimated perceptually whether the display target is reachable or not but without completing any action. Using simple psychophysical function, we can determine the limit of what is reachable on the basis of the responses.



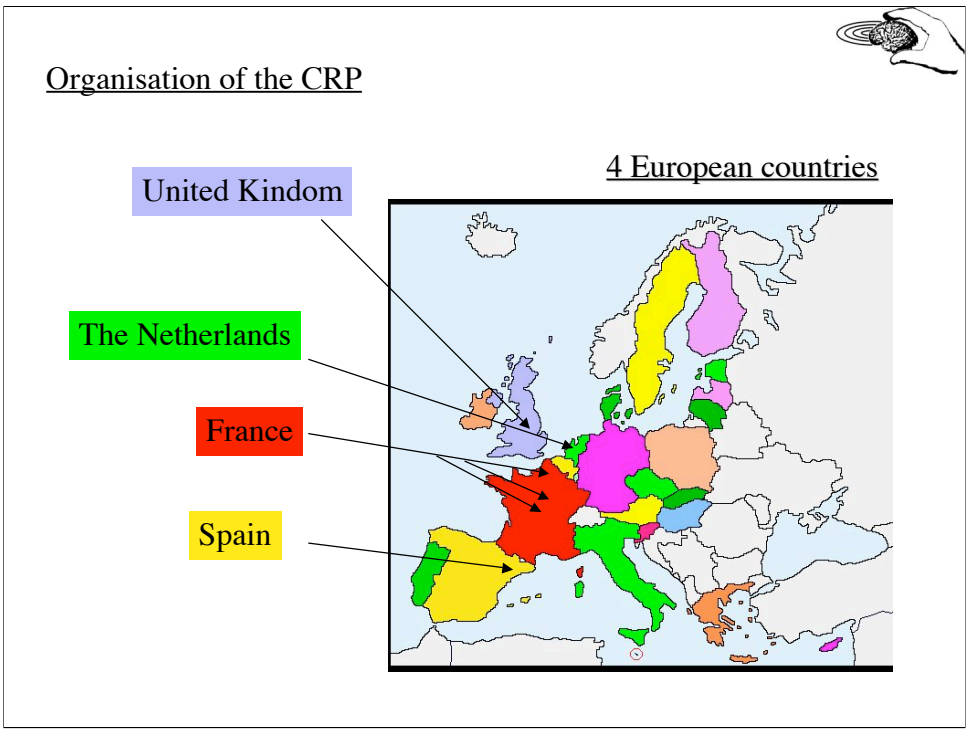
In such situation, motor performance is accurate and the limit of what is reachable extended slightly further than arm length for every individual subject as shown by the radial error computed according to target location or arm length.



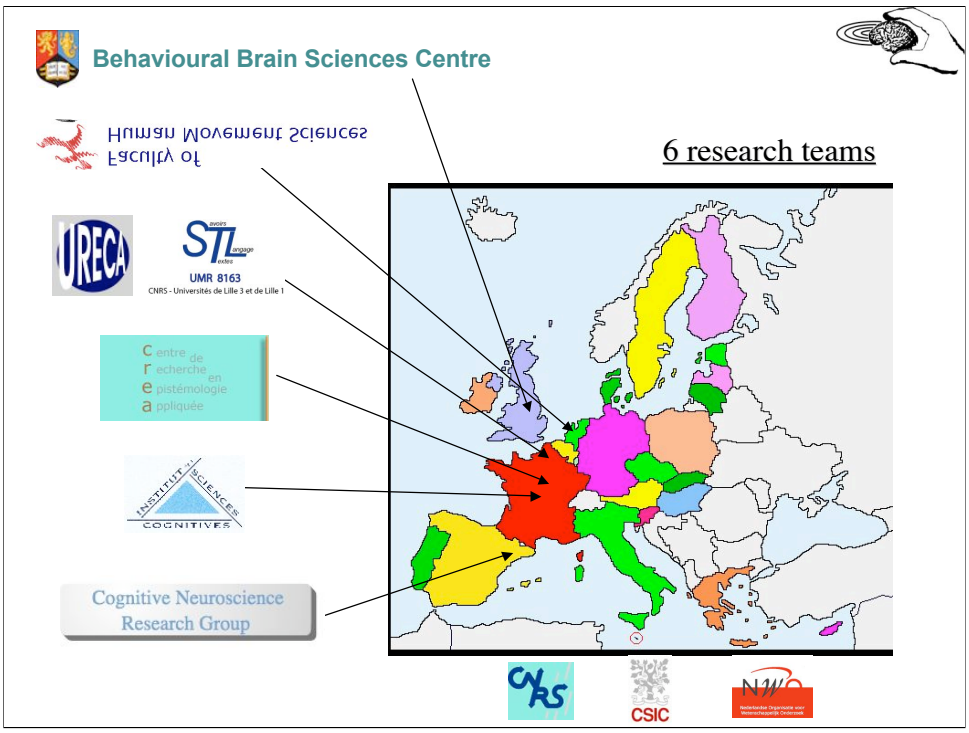
After this first session, a second session was initiated with the difference that the feedback provided during the motor task was biased by +3 cm. The consequence of such biased visual feedback was that visual space in relation to action increases whereas motor space decreases. Consequently, the limit of what is reachable should recede egocentrically only in the case a categorisation of external space based on action capabilities.



This is indeed what we found. Motor performance reduced by 3 cm and the limit of what is reachable by about the same amount.

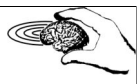


Collaborative Research Project includes 4 countries.



And 6 research teams with acknowledged track records in the field of spatial cognition, perception and motor control in the domain of neuroscience and philosophy, and supported by 3 funding agencies.

24 researchers



Birmingham

Behavioural Brain Sciences Centre

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Martin Edwards (Lect., University of Birmingham)

Amsterdam

Faculty of Human Movement Sciences

Jeroen Smeets (Pr., Faculty movement sciences)
Eli Brenner (Res. , Faculty movement sciences)

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Yvonne Delevoye-Turrell (Mcf, URECA)
Gilles Lafargue (Mcf, URECA)
Arnaud Pagnol (Mcf, URECA)
Angela Bartolo (Post-doc, URECA)
Jacques Honoré (CR1, UMR CNRS 8160)
Pierre Thomas (PU-PH, UMR CNRS 8160)
Alessandro Farné (CR1, INSERM U534)

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Barcelona

Cognitive Neuroscience Research Group

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David T. Field (University of Reading)

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Institut des Sciences Cognitives

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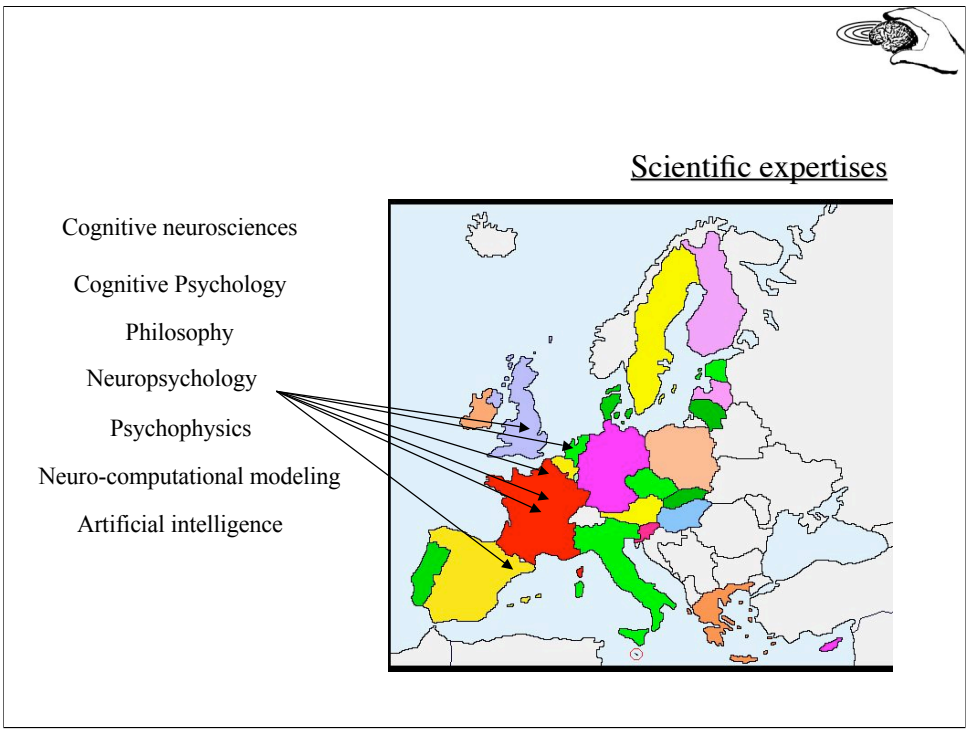
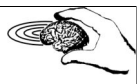
Aurélie Holl (Phd student)


Scientific expertises
Cognitive neurosciences
Cognitive Psychology
Philosophy
Neuropsychology
Psychophysics
Neuro-computational modeling
Artificial intelligence



The scientific program of the project is structured along five experimental lines:

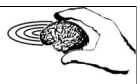
(1) Evaluate the psychophysical relationship between CEWR and the spatial characteristics of motor activity under different environmental contexts

(2) Assess the role of context dynamics and cultural influences in CEWR

(3) Determine the impact of sensory and motor impairments and probe the neural substrates involved in CEWR

(4) Investigate the relation between one's own motor-capabilities and CEWR for others.

(5) Consider the philosophical consequences of a theory of space consciousness based on body and movement properties.

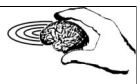


The methodologies used combine:

(1) Experimental approaches and computational modelling.

(2) Identification of neural substrates through neuroimaging techniques, non-invasive brain stimulation and neurological pathology.

(3) Philosophical analysis of the investigation method and the outcome obtained in tasks studying the conscious experience of what is reachable for oneself and for others.

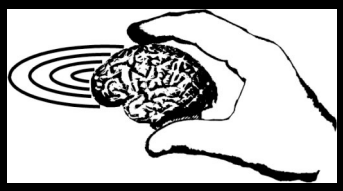


Collaborative work :

1. Effect of changing motor capabilities on CEWR.	⇨	Lille, Paris, Amsterdam
2. Effect of non-invasive brain stimulation on CEWR.	⇨	Lille, Birmingham
3. FMRi study of CEWR	⇨	Birmingham, Lille
4. Temporal and spatial aspect of motion on CEWR	⇨	Barcelona, Amsterdam
5. Effect of linguistic encoding on CEWR	⇨	Barcelona, Paris
6. Effect of motor and brain pathology on CEWR	⇨	Bron, Lille
7. Sensori motor integration modelling and CEWR	⇨	Amsterdam, Barcelona
8. Philosophical approach of CEWR	⇨	Paris, Lille, Amsterdam, Barcelona, Birmingham, Bron

One of the strengths of the project is that every research topic is tackled by several research centres.

Thank you for your attention !



CEWR
ESF-Eurocores program CNCC
2006-2009