

EPFL

Course Virtual Reality
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Embodied Virtual Reality Limits and applications

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We can only experience the world from the perspective of our body.

Virtual Reality Embodiment allows experiencing the world from the perspective of another body.

Embodiment

- **Avatar**
 - Self-representation of a participant
 - ≠ virtual human / 3D character / NPC
- A concomitant factor to Presence

The perceiving of one's world entails the co-perceiving of where one is in the world

Gibson, 1979.



J. Lanier dataglove (1987)

Sense of Embodiment

- Definition *

The ensemble of sensations that arise in conjunction with being inside, having, and controlling a body.

- Sense of self-location
- Sense of agency
- Sense of body ownership

Kilteni, K., Groten, R. and Slater, M. (2012) 'The Sense of Embodiment in Virtual Reality', *Presence* 21(4), 373–387.

* Most widely accepted in the VR community

VR Embodiment via 1PP + Visuomotor Synchrony



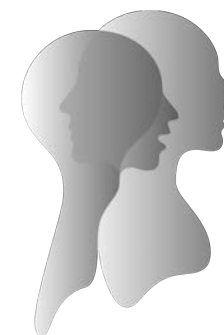


What are the conditions and limits of VRE?

Research work by Ronan Boulic (Immersive Interaction Group, EPFL) and Bruno Herbelin (LNCO, EPFL)



BLANKE
LAB



CHAIR IN COGNITIVE
NEUROPROSTHETICS

Physiological measure of Presence Fear induction in the virtual pit room

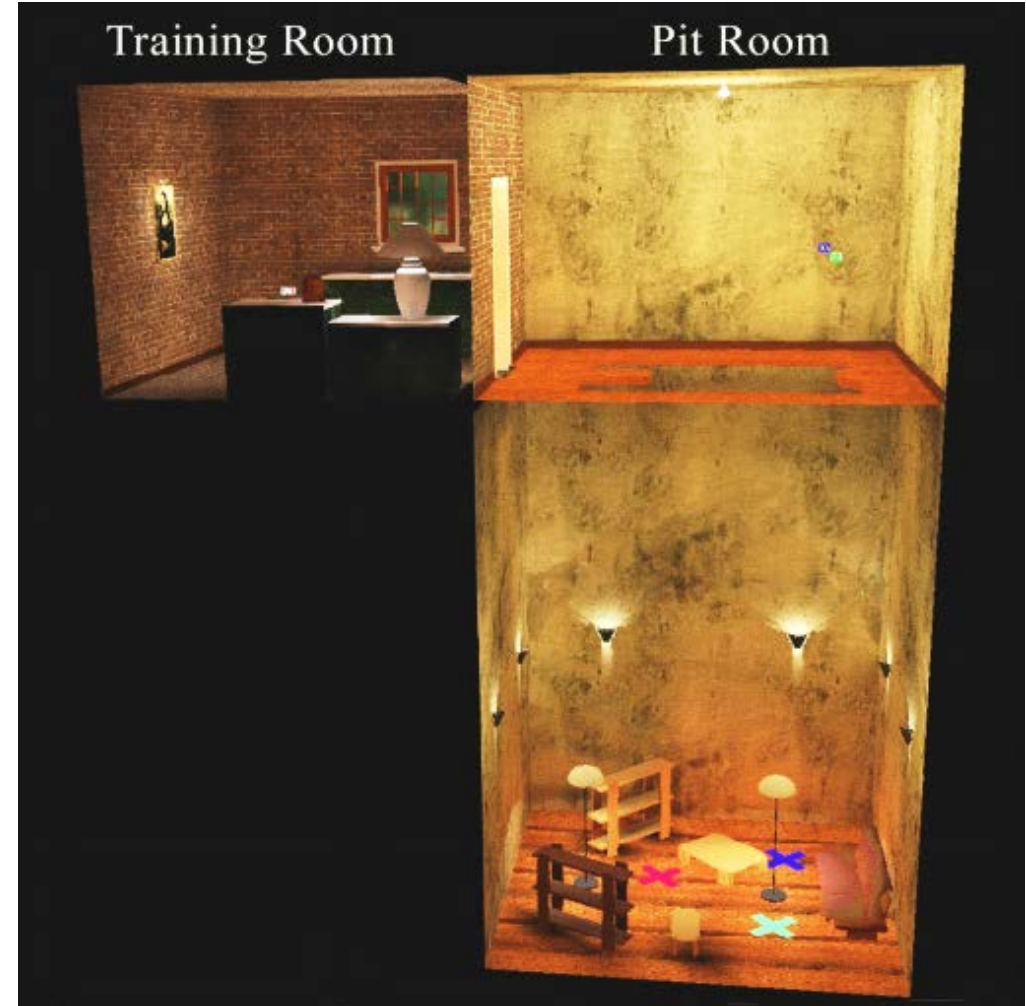
Augmented Environment Lab 2007 Virtual Pit

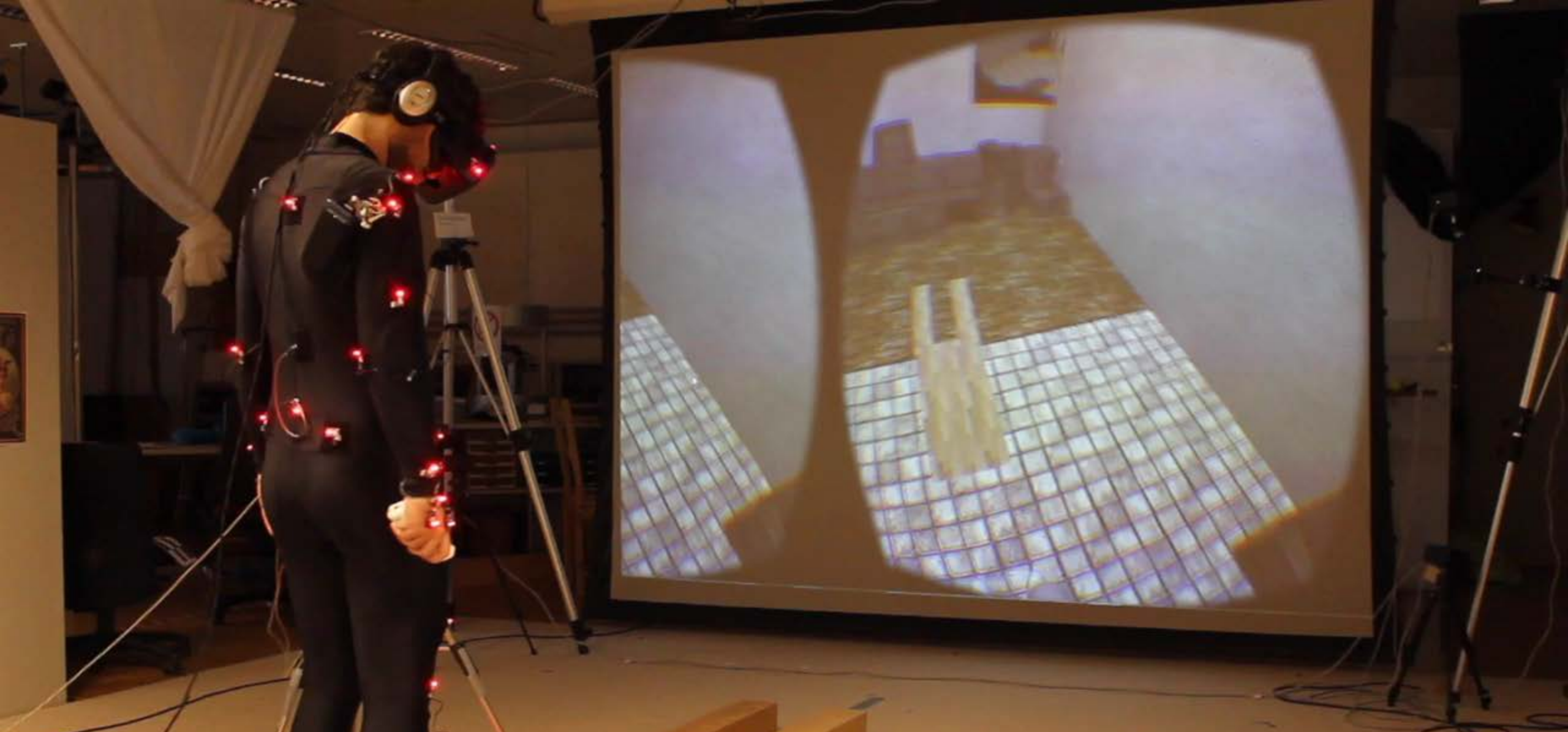


Meehan et al. 2002

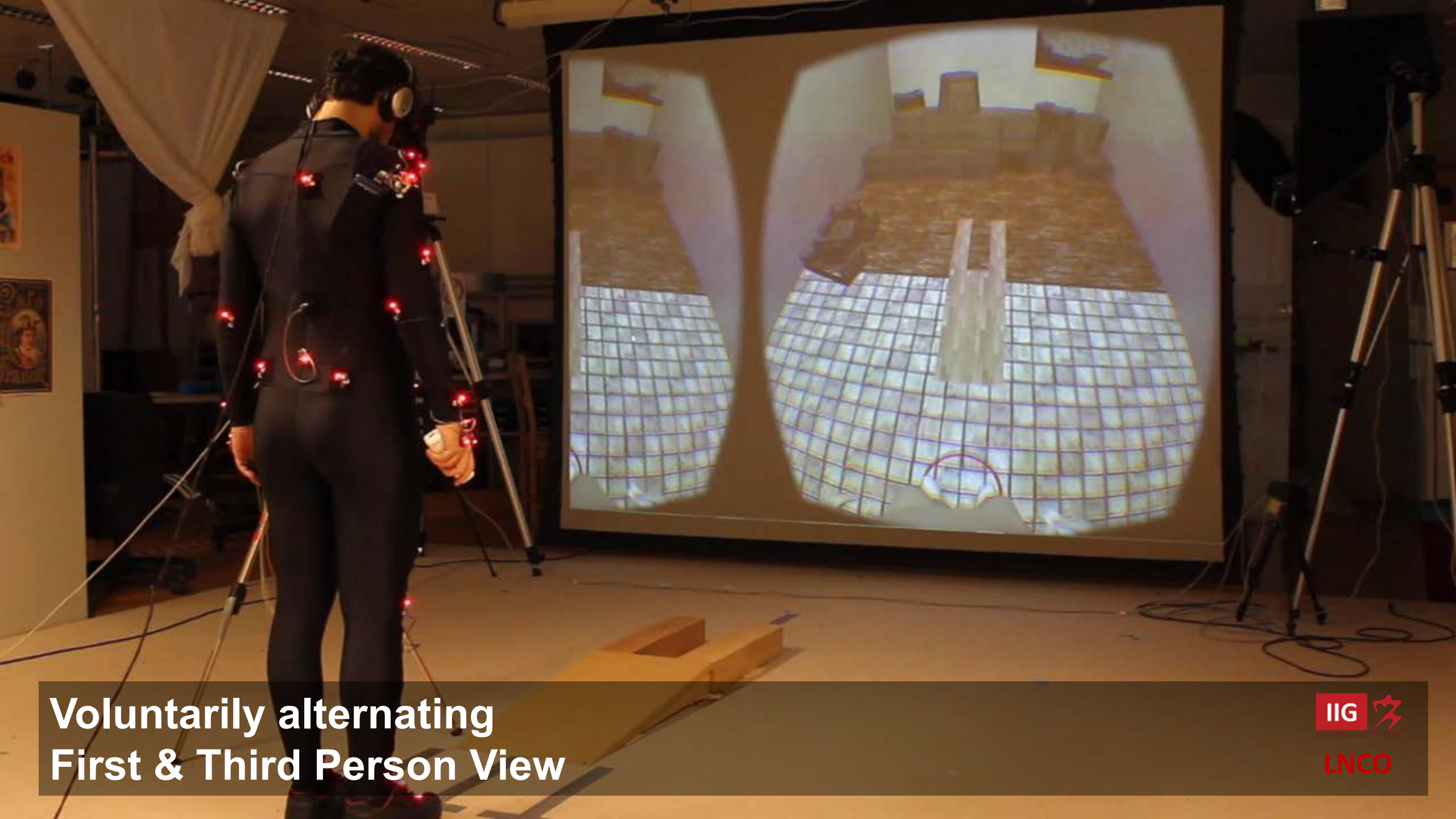


Measure of fear with physiological sensors
(GSR, ECG) shows high reaction
to fear of height





Comparing First & Third Person View

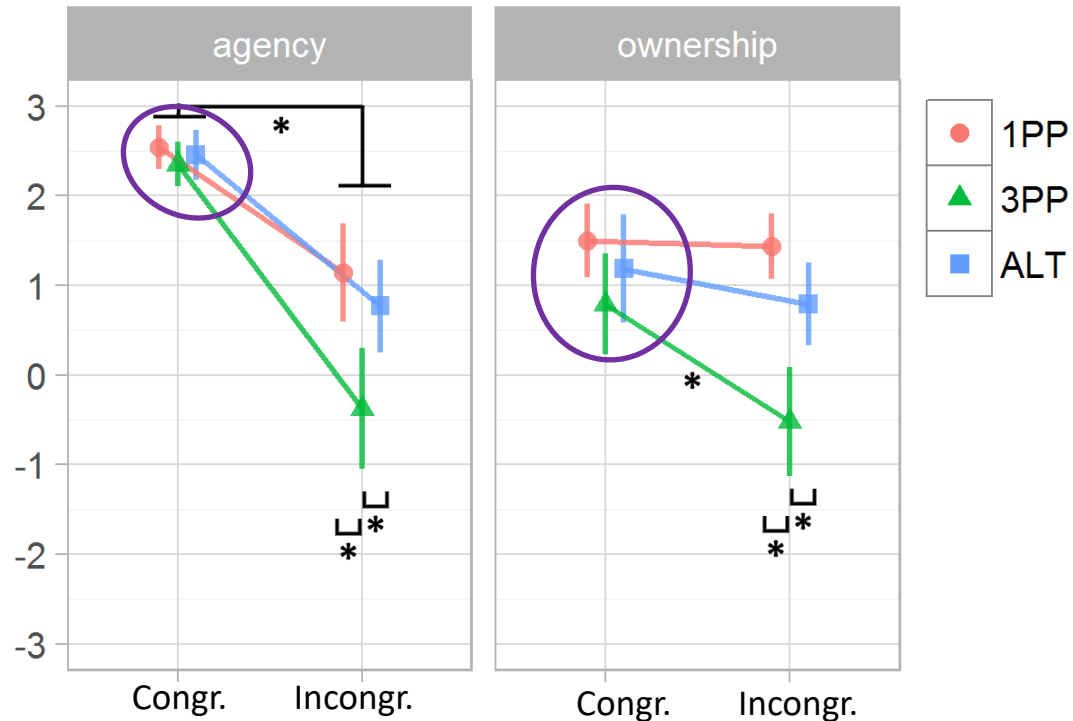


**Voluntarily alternating
First & Third Person View**

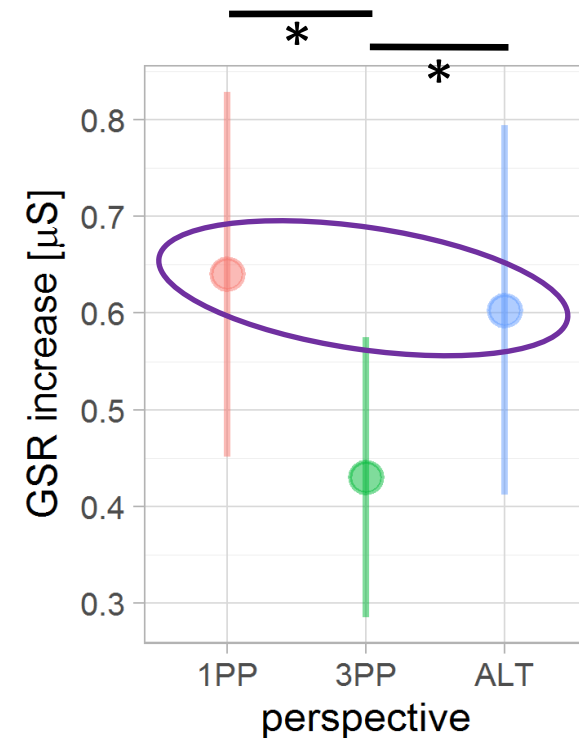
Voluntarily alternating First & Third Person View

Galvan-Debarda et al. –PLOS ONE 2017

Questionnaire result



Galvanic skin response to threat



Strong embodiment in congruent visuo-motor-tactile condition for both 1st and 3rd P. view

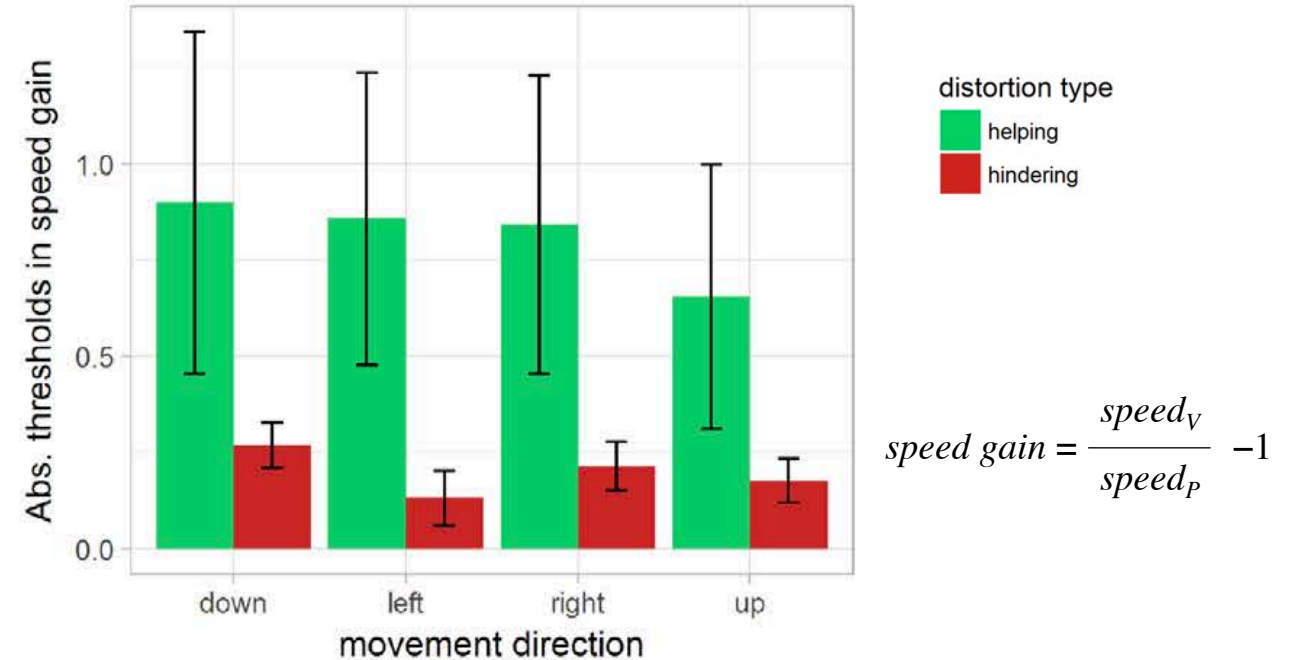
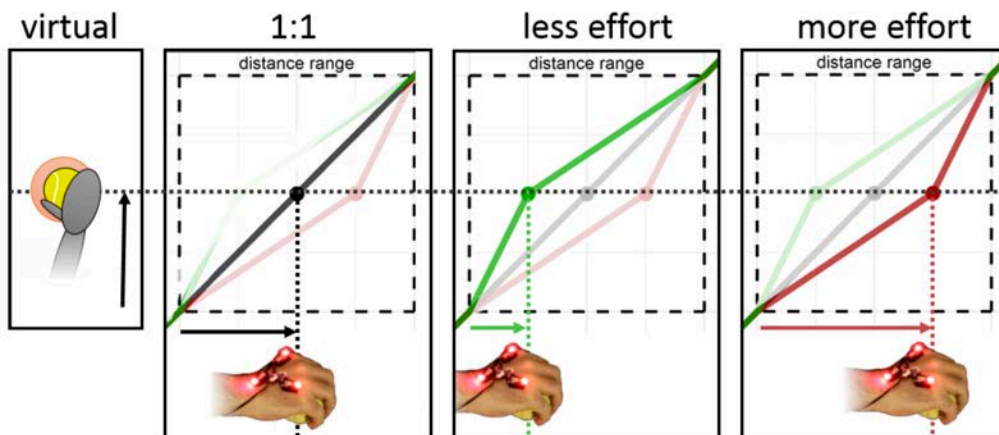
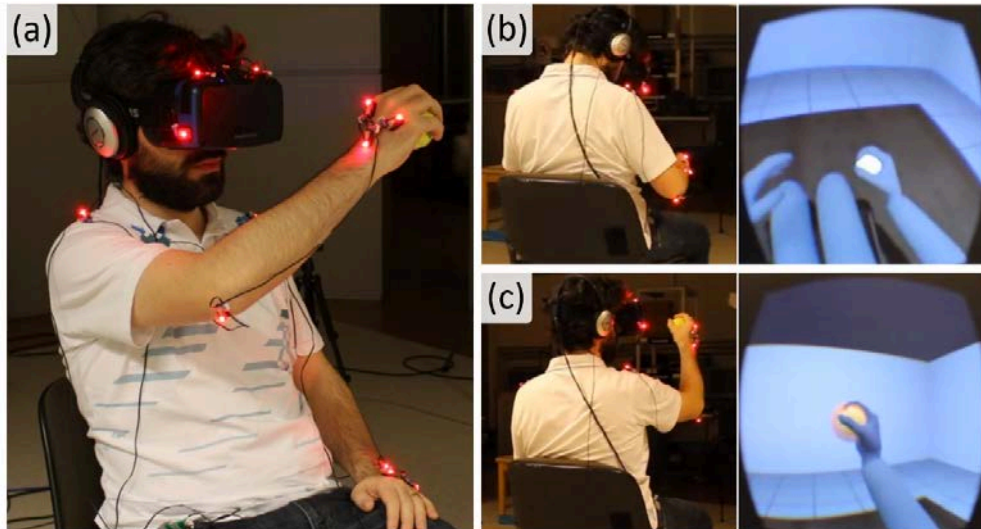
Alternating views can combine the advantages of both



Self-Attribution of Distorted Reaching Movements

Self-Attribution of Distorted Reaching Movements

Galvan-Debarda et al. 2018 –
Computer & Graphics 76(142-52)

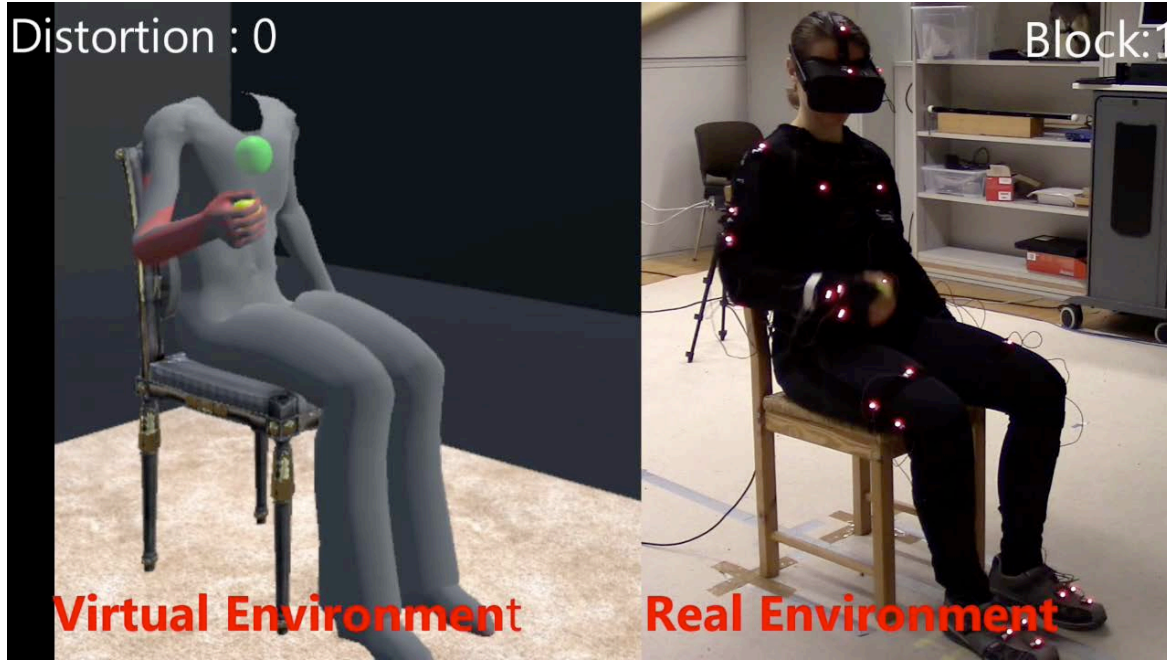


Helping reaching movement is good and not easily detected

Hindering movement is critical

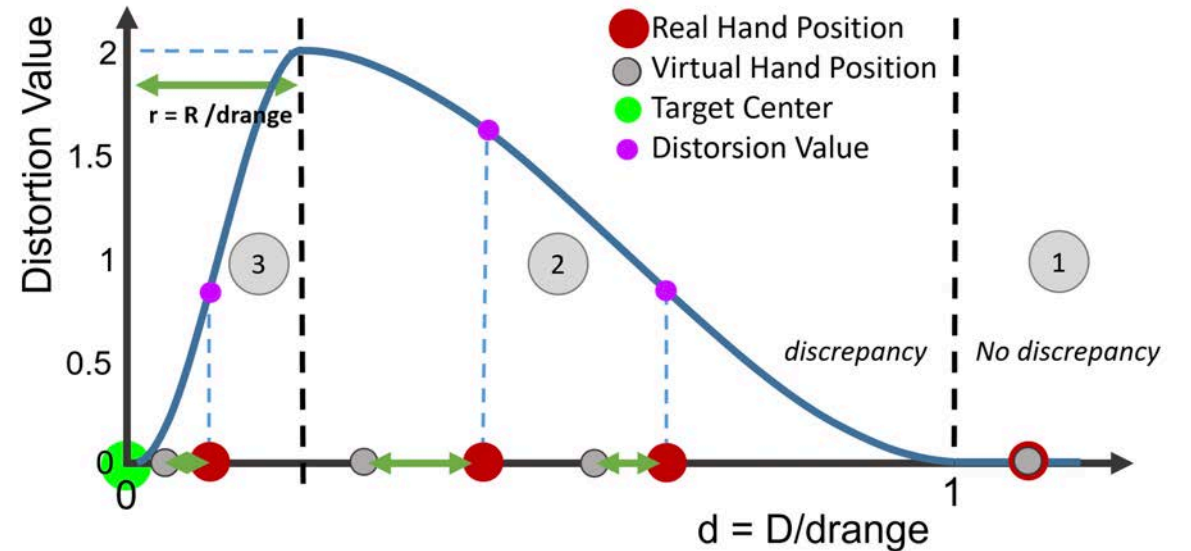
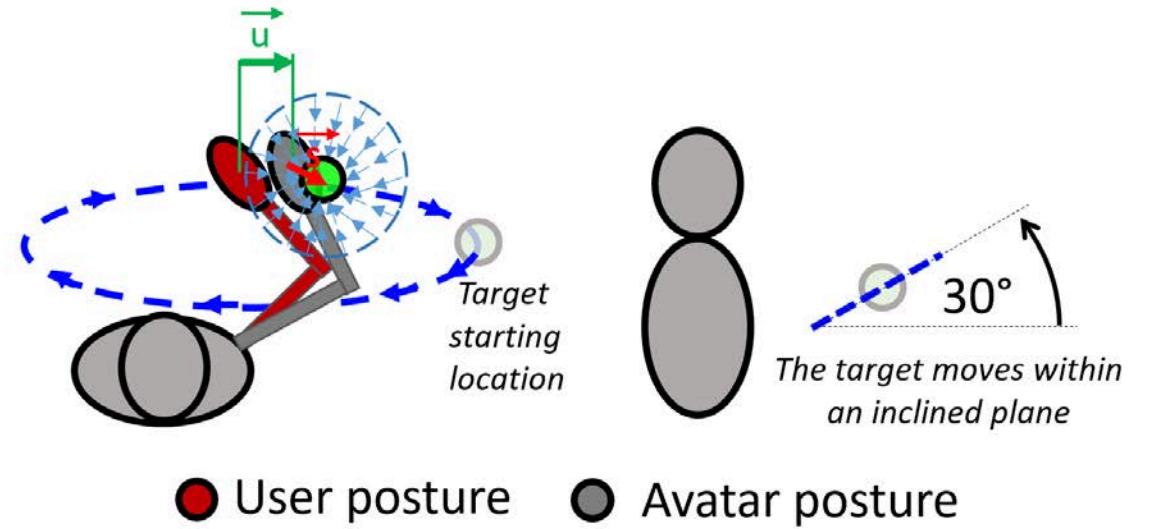
Reconciling Being in-Control vs Being Helped

Porssut et al. – Accepted IEEEVR 2019



BLOC 1 - Self-attribution Threshold

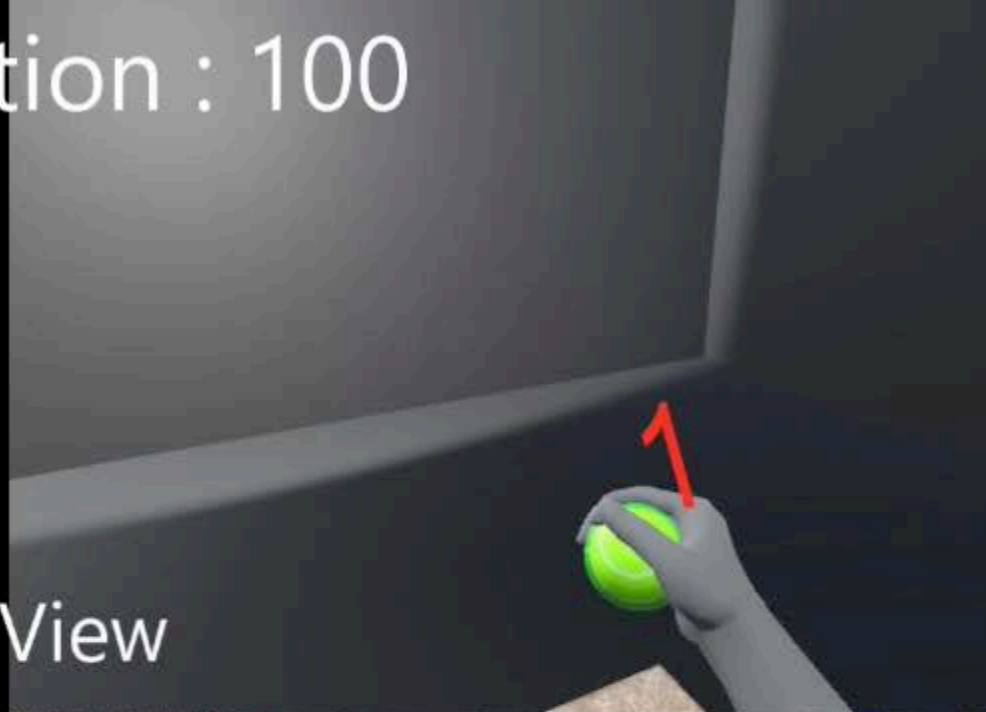
BLOC 2 – Progressive Distortion



Distortion : 100

Training only

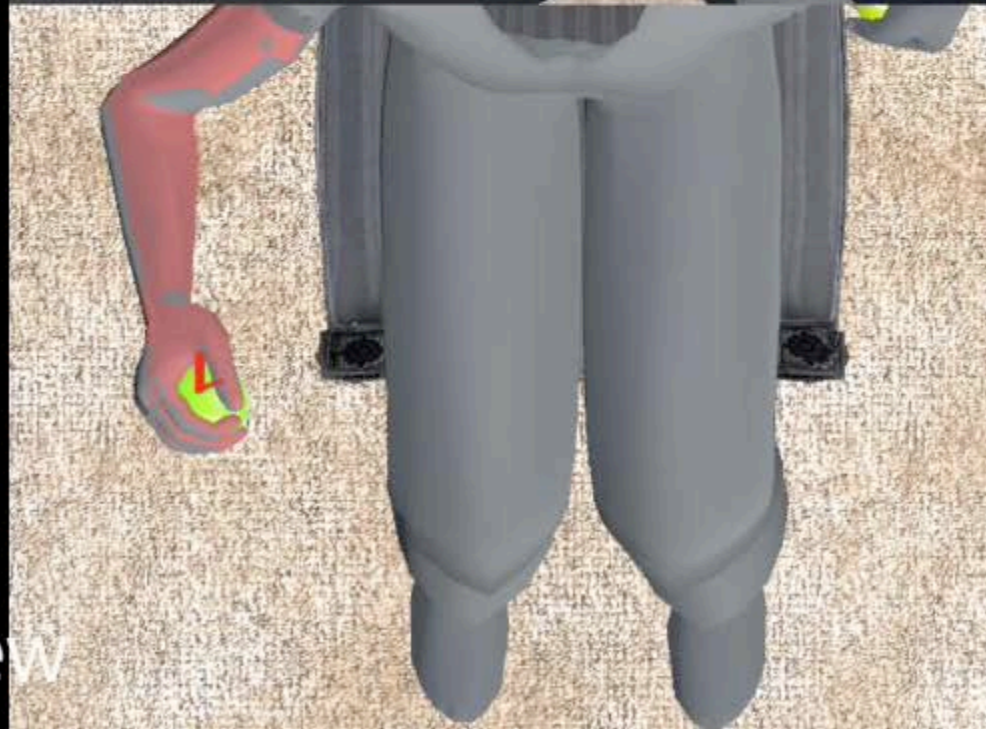
Subject View



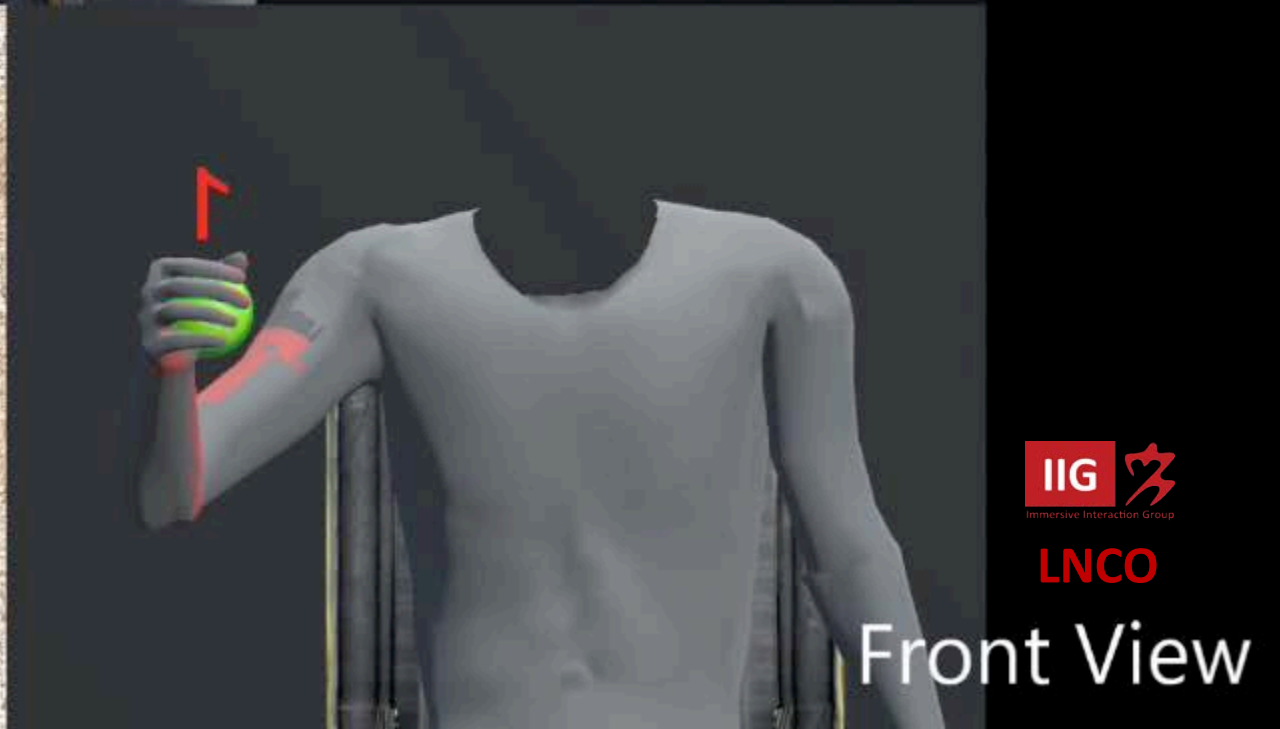
Side View



Top View



Front View

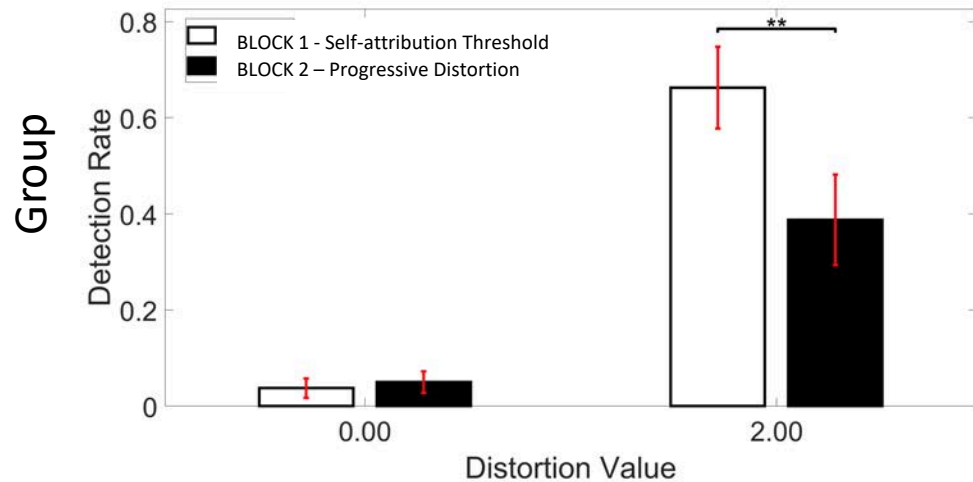
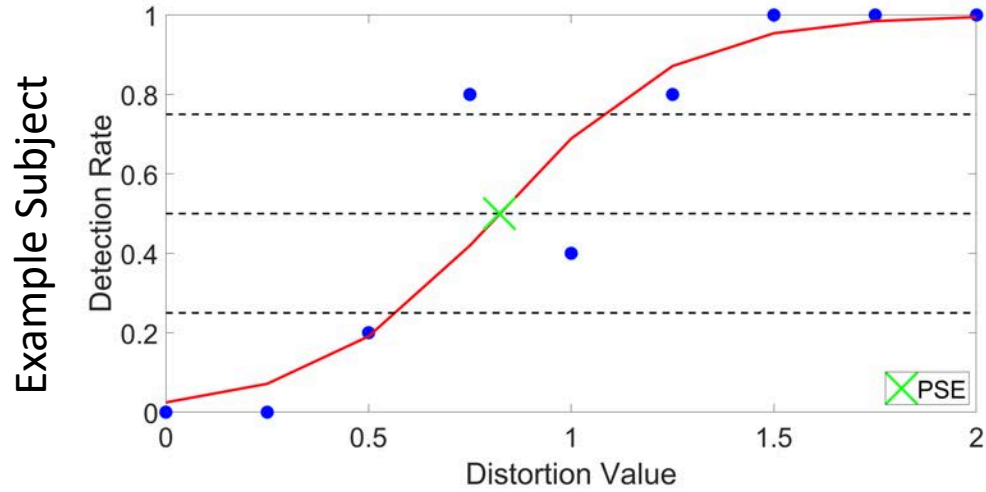


LNCO

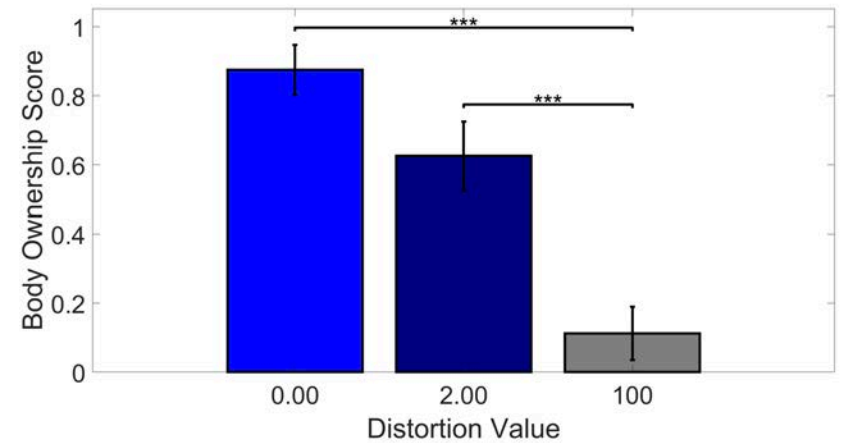
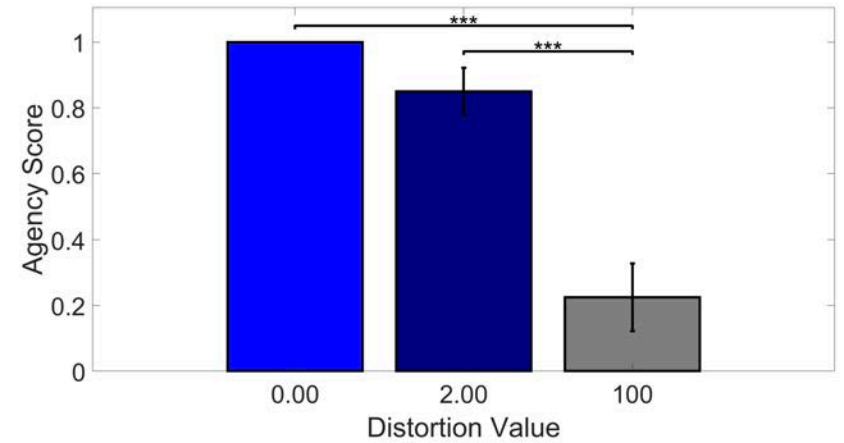
Reconciling Being in-Control vs Being Helped

Results (N=24)

DETECTION RATE



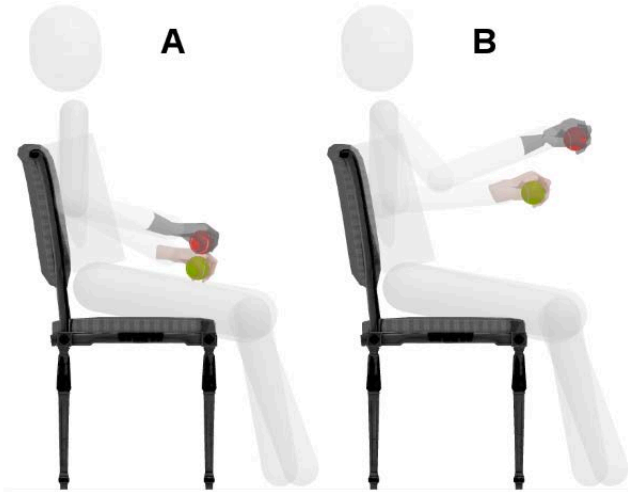
AGENCY AND OWNERSHIP



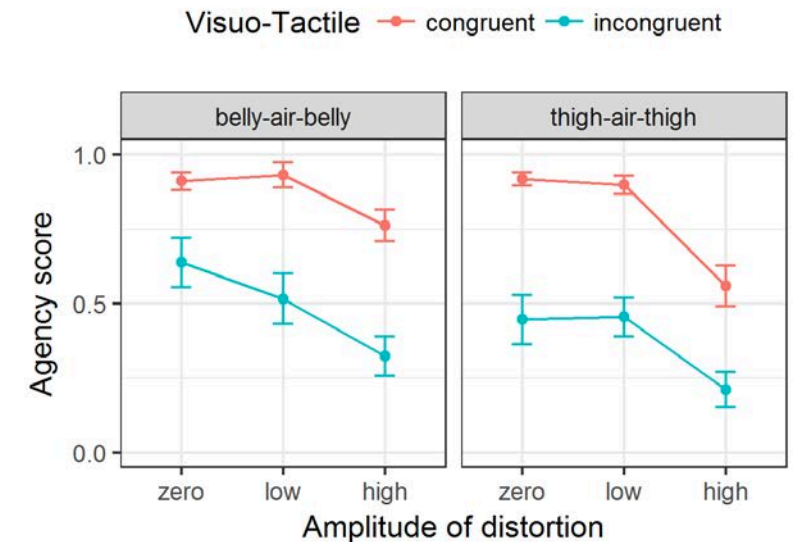
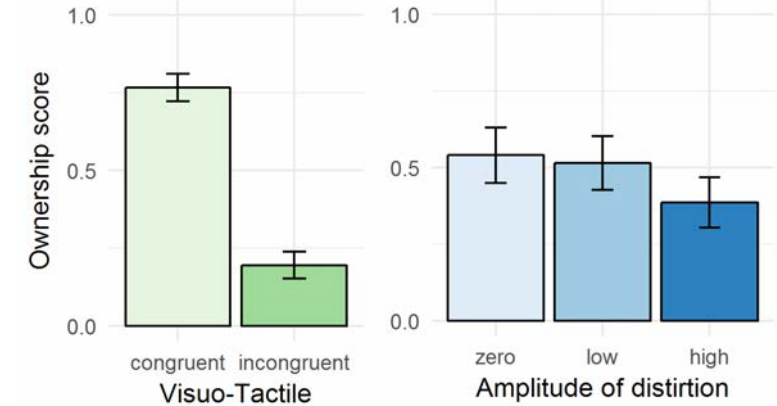
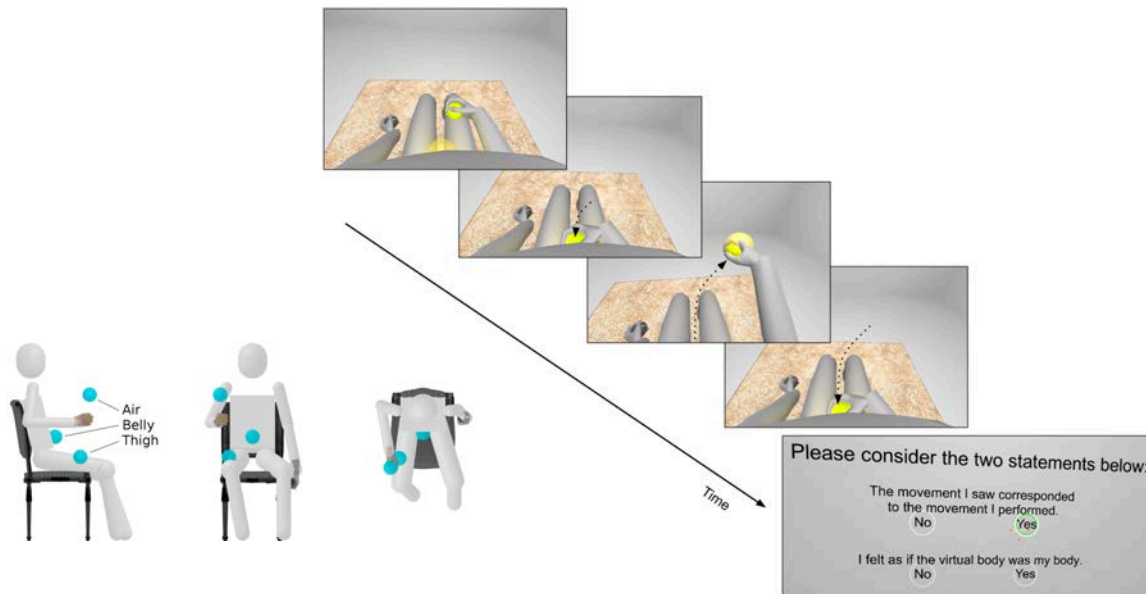
**Self-Contact Visuo-tactile
Congruency is stronger than Agency**

Self-Contact Visuotactile Congruency

Bovet et al. – IEEEVR 2018



*Self-Touch is critical,
And more important
than agency*



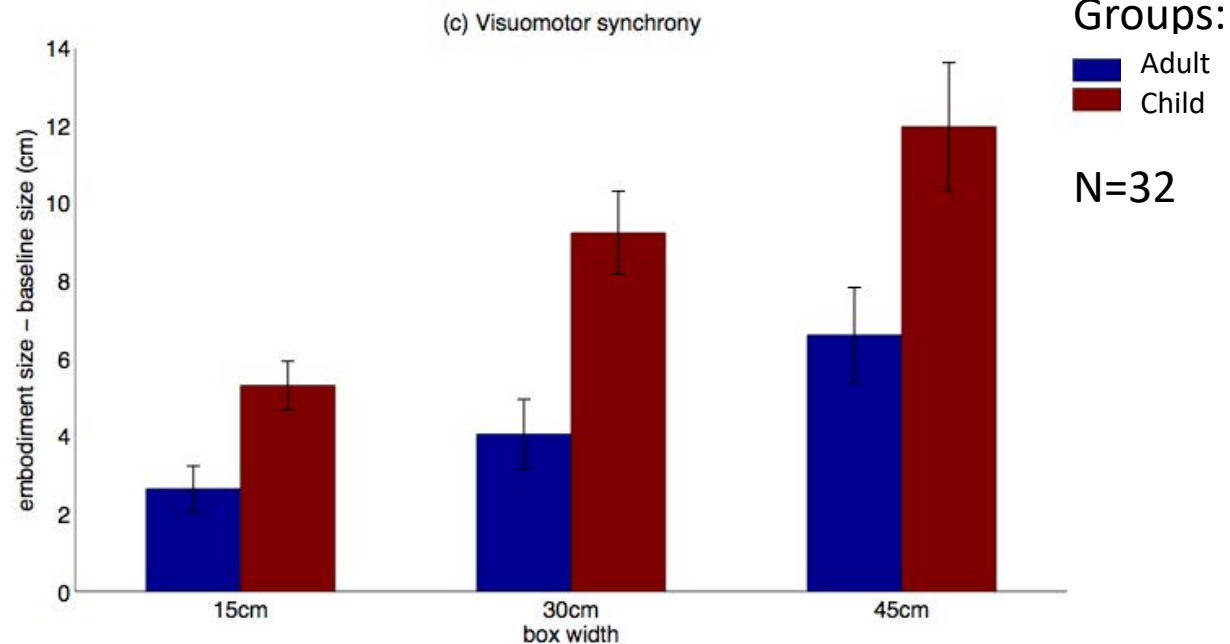


Changes in body representation lead to changes in perception, attitudes and behavior

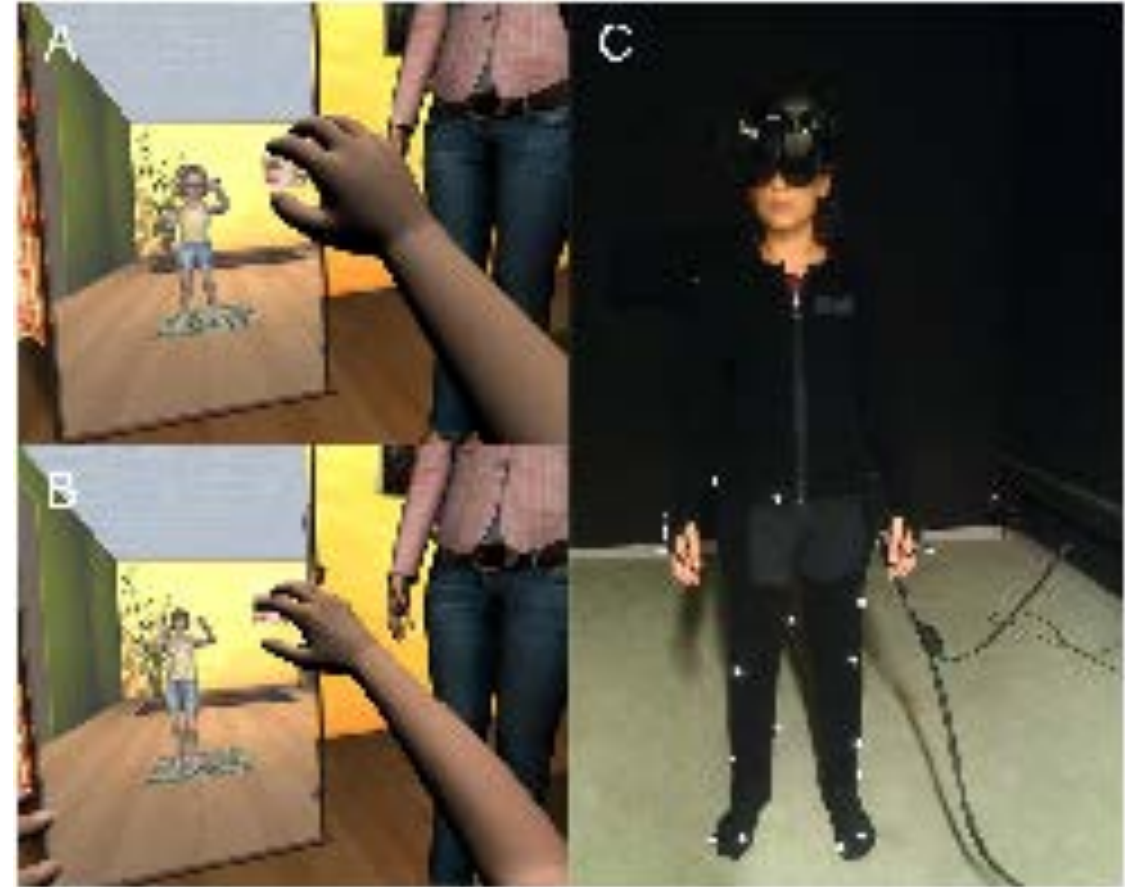
Examples from **eventLab**
Prof. Mel Slater
Barcelona University

Becoming a Child

Just a few moments of multisensory stimulation leads to changes in size perception and self-attributions.



Both groups overestimated the sizes of objects. Those in the child group double overestimated.



Banakou, Groten, Slater (PNAS, July 2013)

Transforming the Self into a Child

Domna BANAKOU¹, Raphaela GROTEN¹, Mel SLATER^{1,2,3}

¹ Facultat de Psicologia , Universitat de Barcelona, Barcelona, Spain

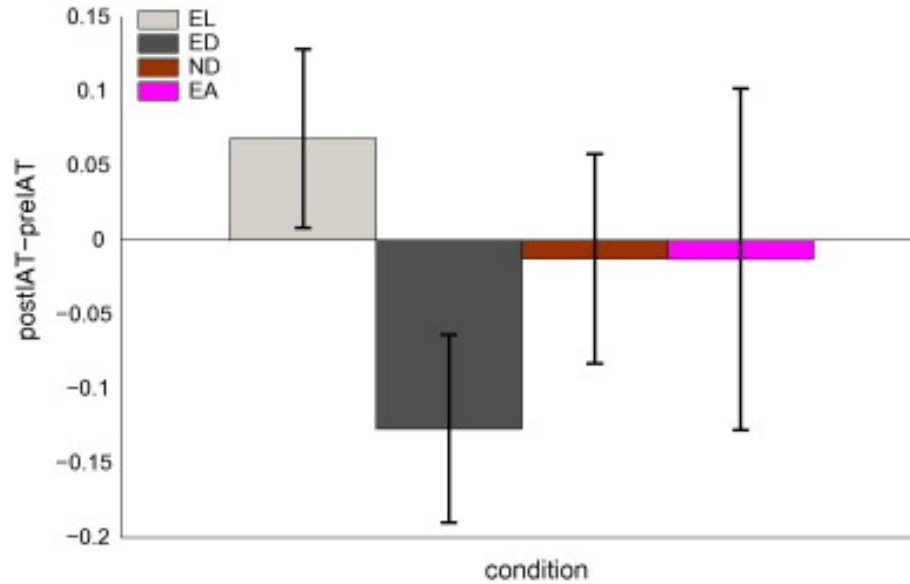
² Institutio Catalana Recerca i Estudis Avançats (ICREA), Universitat de Barcelona, Barcelona, Spain

³ Department of Computer Science, University College London, London, United Kingdom

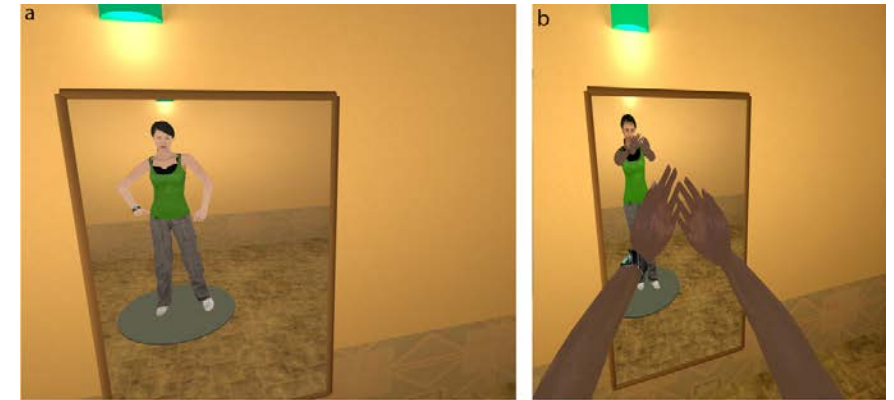
Reducing Implicit Racial Bias

Putting yourself in the skin of a black avatar reduces implicit racial bias

increased bias



decreased bias



Banakou, Groten, Slater (2013) PNAS

Peck, Seinfeld, Aglioti, Slater (2013) Consc. & Cogn

Experimental conditions:

- Embodied-Light-Skinned (EL)
- Embodied-Dark-Skinned (ED)
- Non-Embodied Dark-Skinned (ND)
- Embodied-Alien-Skinned (EA)

Note

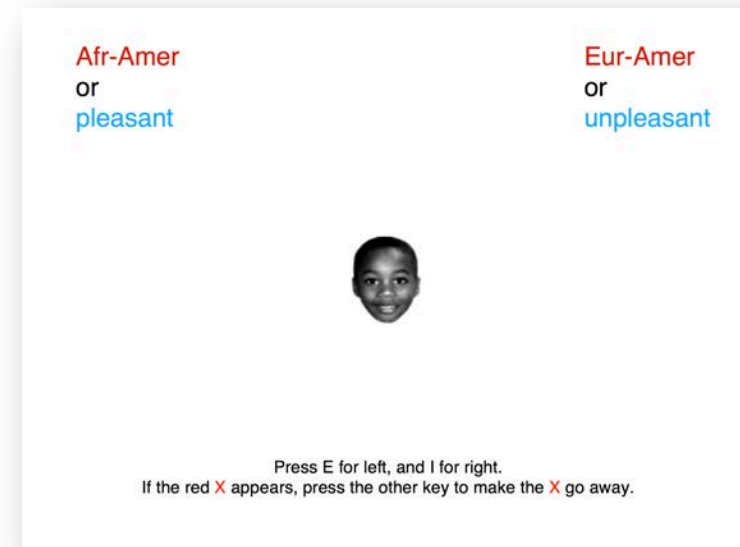
Implicit Association Test (IAT)

If 'Black' are faces paired with negative words and 'White' faces with positive words faster than the other way around, this shows an *implicit* bias.

Note this does not mean that the person is prejudiced but reflects *implicit* bias (which may be socially determined)

See

<https://implicit.harvard.edu/implicit/demo/>



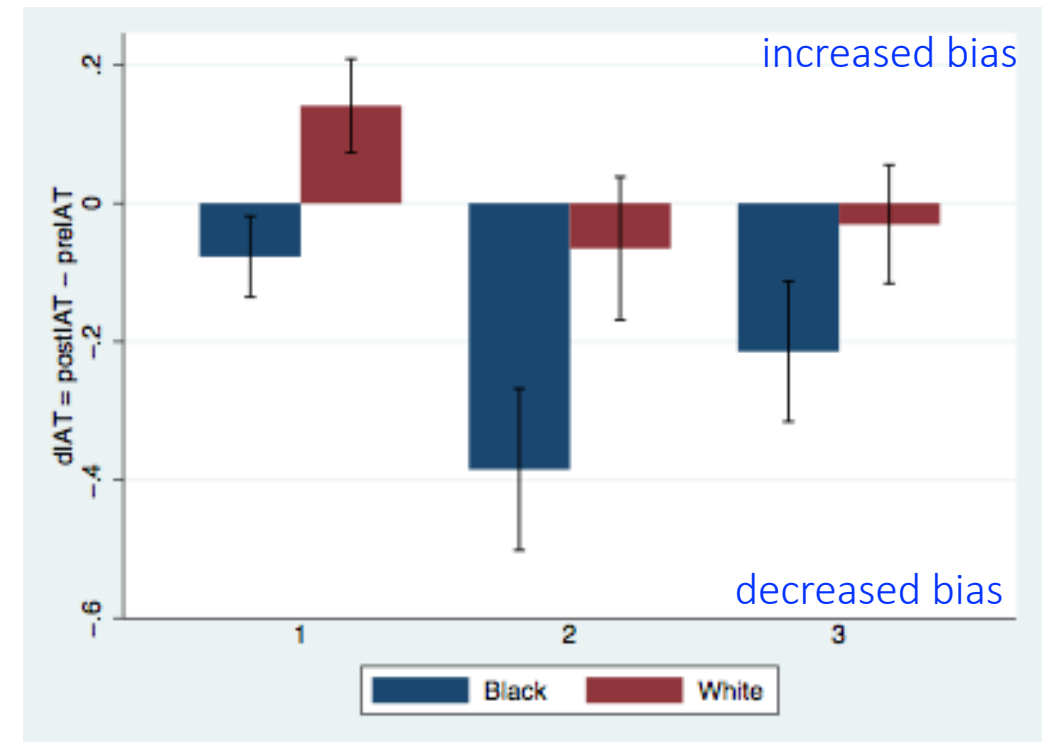


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Repetition study - embodiment of White people in Black body reduces implicit bias?

- Between Groups Design: 3 groups
 - 1, 2, or 3 exposures, each separated by 3 days
- IAT measured 1 week before 1st exposure
- IAT measured 1 week after last exposure
- Diminution lasts at least 1 week after the end of the exposure
- One exposure is sufficient to observe this effect

Change in IAT (N = 89)



Self Counselling

Basic idea: talking with yourself as if with another person could be helpful for personal problem solving.



Self Avatar



Osimo, S. A., Pizarro, R., Spanlang, B., & Slater, M. (2015).
Scientific Reports.

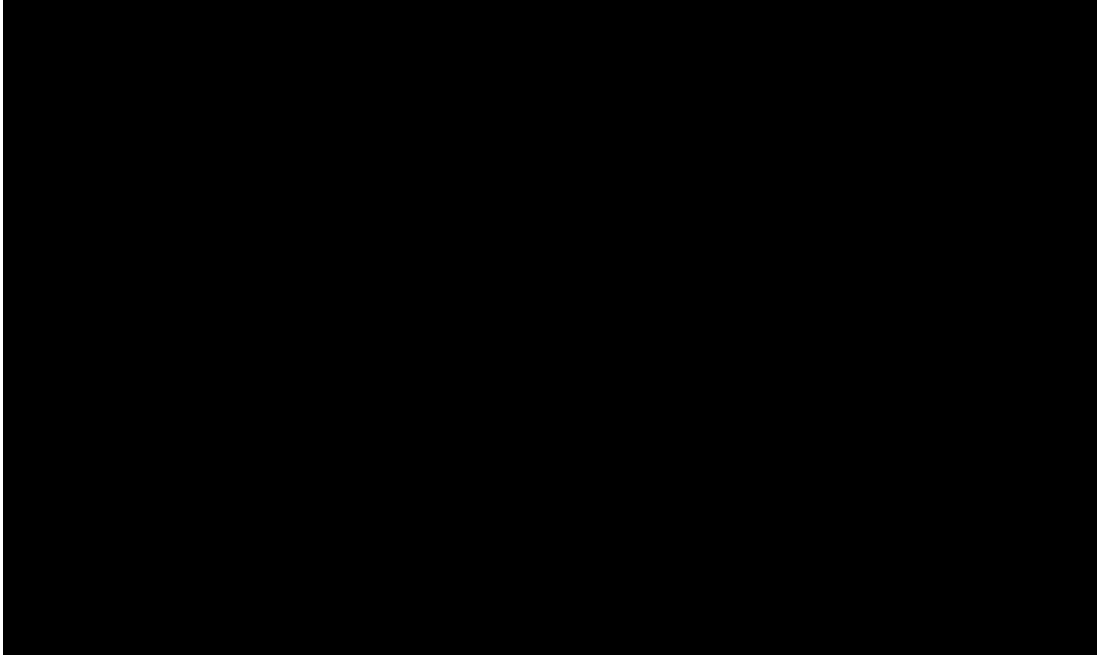


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Conversations between Self and Self as **Sigmund Freud**

A Virtual Body Ownership Paradigm for Self Counselling

Potential social impact



Observation on violence of soccer supporters:
identification with the victim (supporter of same club)
leads subject to want to help



Application against domestic violence: rehabilitation
of offenders by embodiment into a woman's body

*Work led by Dr Mavi Sanchez-Vives with Justice Dept
Catalonia*



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Mel Slater, University of Barcelona

Synthesis



- Technologies for Virtual Reality Embodiment are available and effective
- Embodiment is robust to
 - Change of perspective
 - Movement distortion
 - Various appearance
 - Change of body
- Experiencing being in a different body impacts our perception and judgement of the world

Acknowledgements



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