Action co-representation: A comparison study between Human-Human and Human-Robot Interaction

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Le " SAUT DE LA MORT "
par les " CLERANS "
The Clerans

Action co-representation

Joint task = “any form of social interaction whereby two or more individuals coordinate their actions in space and time to bring about a change in the environment” *Sebanz et al., 2006*

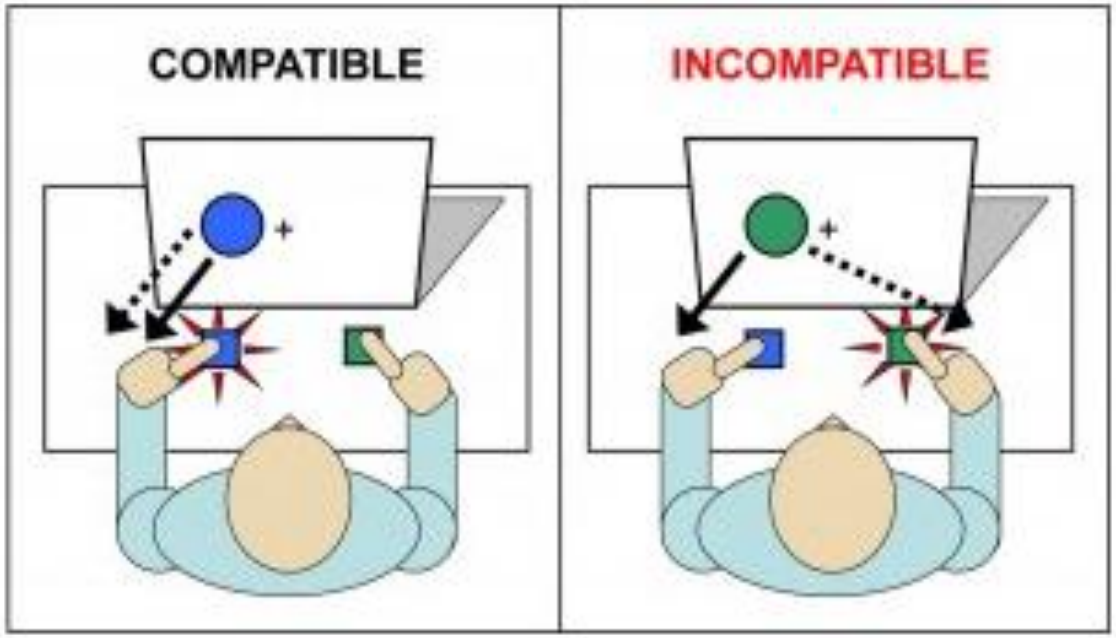
- Social Simon effect *(Hommel, Colzato, & van den Wildenberg, 2009; Sebanz et al., 2003)*

Hommel, B., Colzato, L. S., & van den Wildenberg, W. P. (2009). How social are task representations? *Psychological Science, 20,* 794-798.
Sebanz, N., Bekkering, H., & Knoblich, G. (2006). Joint actions: bodies and minds moving together. *Trends in Cognitive Sciences, 10*, 70-76.

Simon effect

(Simon & Rudell, 1967)

Simon effect = Spatial compatibility effect

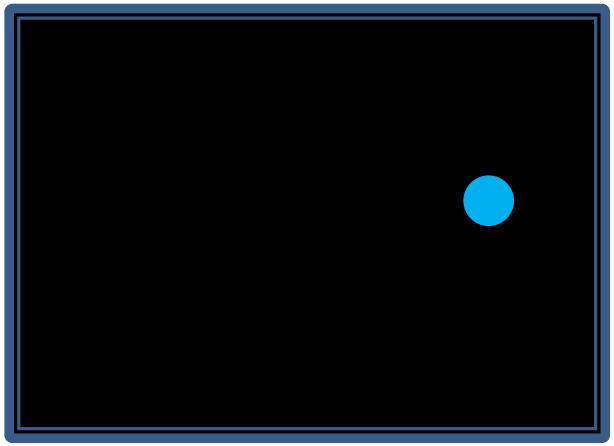


Due to the activation of the concurrent response

Simon, J. R., & Rudell, A. P. (1967). Auditory S-R compatibility: The effect of an irrelevant cue on information processing. *Journal of Applied Psychology, 51,* 300-304.

When the task is realized in a go/no-go type:

- Go: Response
- No-Go: No Response



The Simon effect disappears

Sebanz, N., Knoblich, G., & Prinz, W. (2003). Representing others' actions: just like one's own? *Cognition, 88*, 11-21.

- Nevertheless…

When the task is shared with a partner…

The effect reappears!

This is the so-called « **social Simon effect** »
(Hommel et al., 2009)

Hommel, B., Colzato, L. S., & van den Wildenberg, W. P. (2009). How social are task representations? *Psychological Science, 20,* 794-798.
Sebanz, N., Knoblich, G., & Prinz, W. (2003). Representing others' actions: just like one's own? *Cognition, 88*, 11-21.

Interpretation of the social Simon effect

Why is there a spatial coding (left/right) of the response in a joint go/no-go task?

Social Account	The presence of another induces co-representation of his action
Hypothesis of a referential coding	The presence of someone else, or of another event creates a response conflict that the actor is supposed to resolve by amplifying (focusing on) some characteristics of the response that allow to discriminate his own response from those of the other (here spatial dimension)

Determinant of the social Simon effect

- Influence of the co-actor origin: **action co-representation is biologically tuned** *(Tsai & Brass, 2007)*

a Experimental Setting

b Human-Hand Model

c Wooden-Hand Model

-A specific cerebral mechanism could facilitate social interaction with individuals from our own species

-The representation of biological vs. non biological movement would be fundamentally different *(Press, 2011; Tsai et al., 2007)*

- If the cognitive system reacts to non-human actions as for human actions = attribution of human properties to the non-human agent (as mental states for example, *Gazzola et al., 2007)*

Gazzola, V., Rizzolatti, G., Wicker, B., & Keysers, C. (2007). The anthropomorphic brain: the mirror neuron system responds to human and robotic actions. *NeuroImage, 35*,1674-1684.

Press, C. (2011). Action observation and robotic agents: Learning and anthropomorphism. *Neuroscience and Biobehavioral ,35,* 1410–1418.

Tsai, C. C., & Brass, M. (2007). Does the human motor system simulate Pinocchio's actions? *Psychological Science, 18,* 1058-1061.

- preference for human actions: because human actions have been observed more frequently and in the same time associated with the execution of corresponding actions *(Heyes, 2010; Press, 2011)*

The detection of an equivalence between others' actions and those we produce ourselves is important for the way we process and interpret the actions from others

(Meltzoff, 2005; Press, 2011)

Heyes, C. M. (2010). Where do mirror neurons come from? Neuroscience and Biobehavioural Reviews, 34, 575-583.

Meltzoff, A. N. (2005). Imitation and Other Minds: The 'Like Me' Hypothesis. In S. Hurley & N. Chater (Eds.), Perspectives on Imitation: From neuroscience to Social Science, Vol. 2: Imitation, human development, and culture (pp. 55-77). Cambridge, MA: MIT Press.

Press, C. (2011). Action observation and robotic agents: Learning and anthropomorphism. *Neuroscience and Biobehavioral ,35,* 1410–1418.

Action of others that produce effects similar to the effects produced by our own actions should be considered as somehow equivalent to our actions *(Dolk et al., 2014)*

Every ‘sensorimotor experience' could play a role in the detection of an equivalence between our actions and those from others

And influence the way we represent and interpret others’ actions

Dolk, T., Hommel, B., Colzato, L. S., Schütz-Bosbach, S., Prinz, W., & Liepelt, R. (2014). The joint Simon effect: a review and theoretical integration. *Frontiers in Psychology, 5*.
Hommel, B. (2009). Action control according to TEC (theory of event coding). *Psychological Research, 73*, 512-526.
Prinz, W. (2005). An ideomotor approach to imitation. In S. Hurley & N. Chater (Eds.), Perspectives on Imitation: From Neuroscience to Social Science (pp. 141-156). Cambridge, MA: MIT Press.

The present study

Hypothesis

- A sensorimotor experience in which the movements of a non-human agent (a robot) are associated to the consequences of our own actions should:

  - increase the similarity between our actions and those from this agent

  - hence changing the way we represent this agent's actions in a joint task situation

- Higher similarity between actor and robot:

  ⇒ response conflict in a joint Simon task
  ⇒social Simon effect *(Dolk et al., 2013, 2014; Hommel, 2009)*

Dolk, T., Hommel, B., Colzato, L. S., Schütz-Bosbach, S., Prinz, W., & Liepelt, R. (2014). The joint Simon effect: a review and theoretical integration. *Frontiers in Psychology, 5*.
Dolk, T., Hommel, B., Prinz, W., & Liepelt, R. (2013). The (not so) social Simon Effect: a referential coding account. *Journal of Experimental Psychology: Human Perception and Performance, 39*, 1248-1260.

Action co-representation and sensorimotor learning

Objectives

-To replicate the existence of social Simon effect when the participant is coacting with a human agent and its absence when the agent is not human (i.e. robotic)

-To demonstrate the **effect of 'sensorimotor experience'** on the social Simon effect

Method

Participants

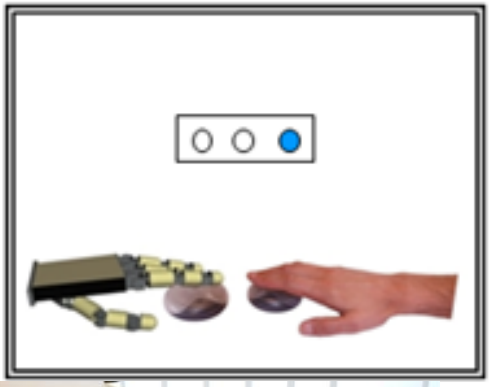
51 students

(36 women, mean age 20.1)

Design

Go/no-go shared task. Pre-Test

2 * 100 trials



Interaction phase

2 * 20 movements

Go/no-go shared task. Post-Test

2 * 100 trials

Design

Interaction phase

Active group
Participant put his hand in the exoskeleton and realized - 20 index finger movements -20 hand opening/ closing While observing the screen

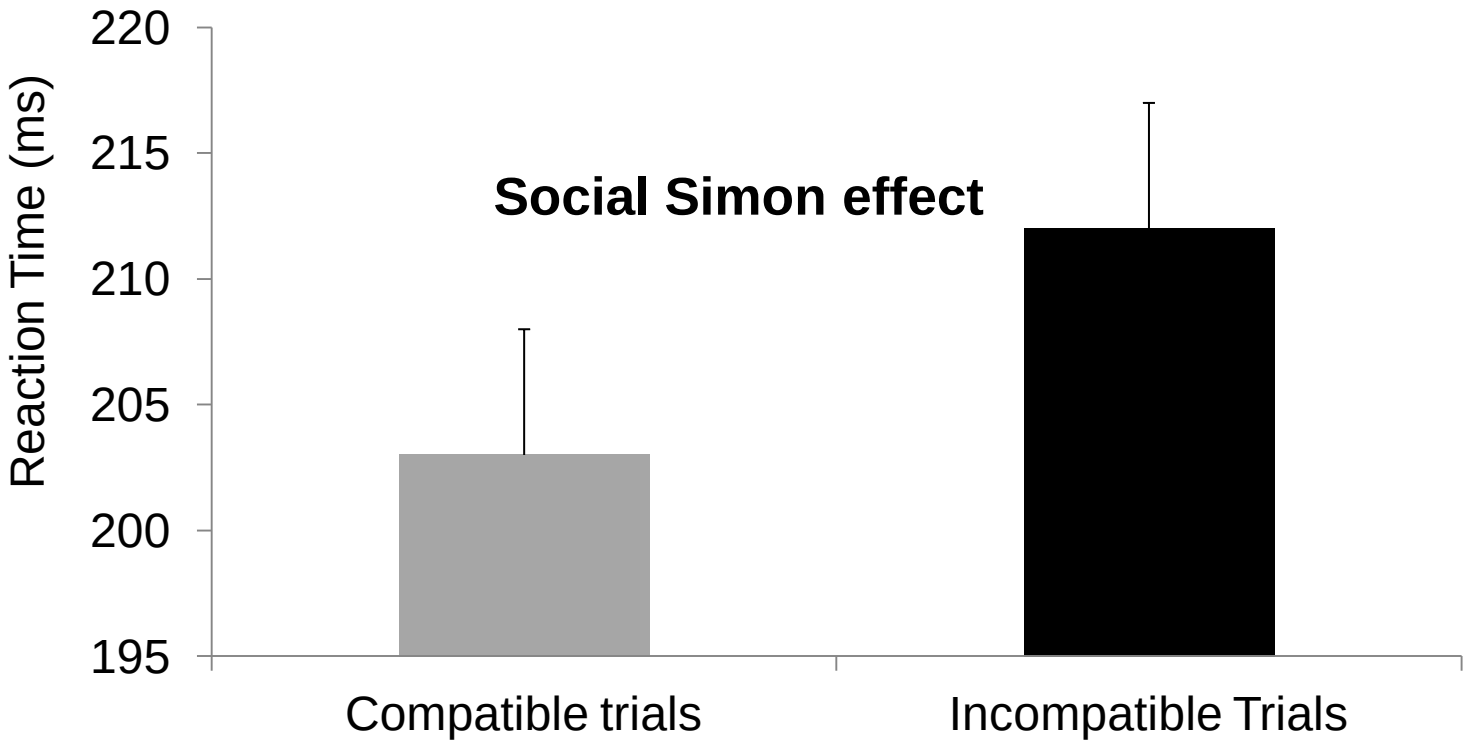
Passive group
- Observes 20 index finger movements -Observes 20 opening/closing hand movements

Results

- Pre-Test: ANOVA on the mean RTs

Significant effect of compatibility**:** ***F*(1, 48) = 20.8, *p* < .001**

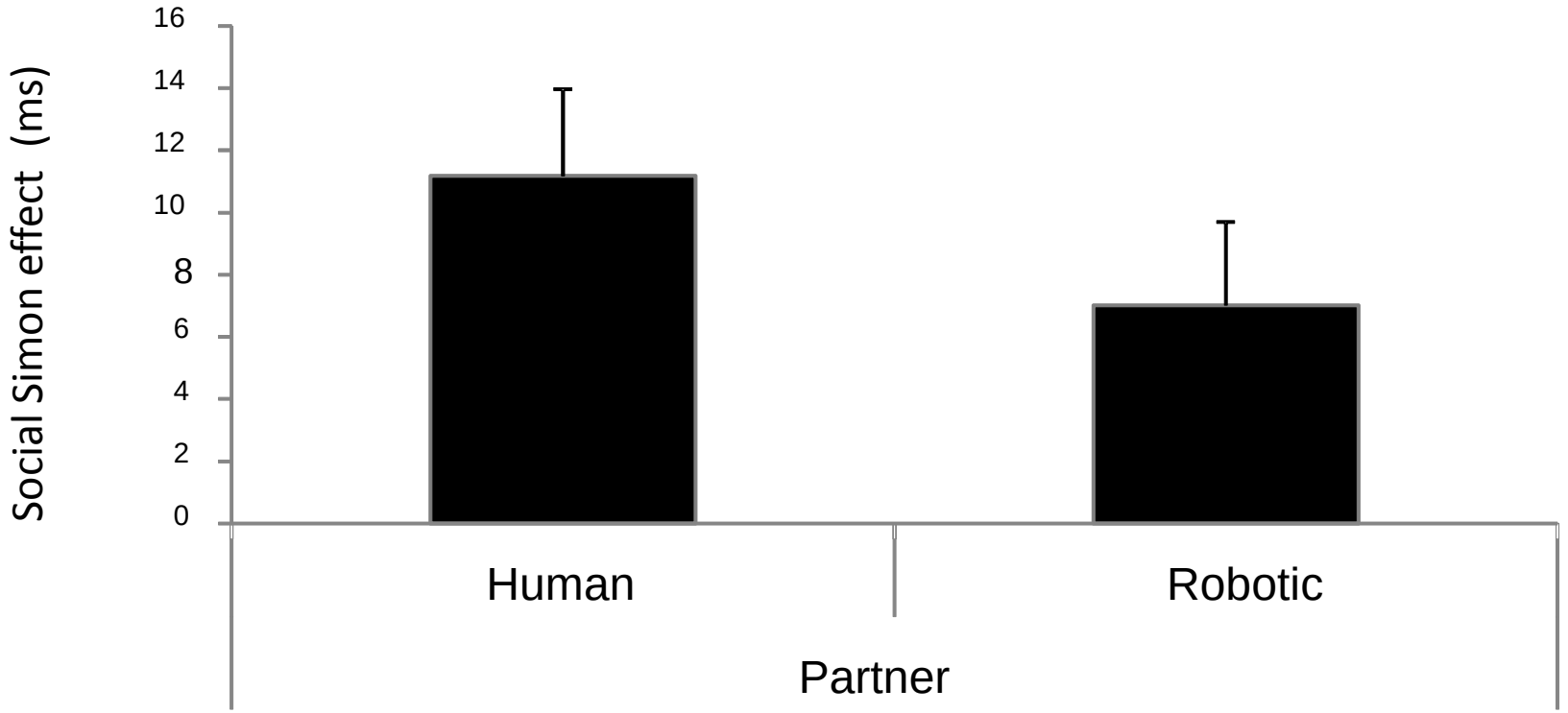
(Compatible trials were significantly faster than incompatibles trials)



Results

- Pre-Test: ANOVA on the mean RTs

Social Simon effect not modulated by the type of partner, $F < 1$

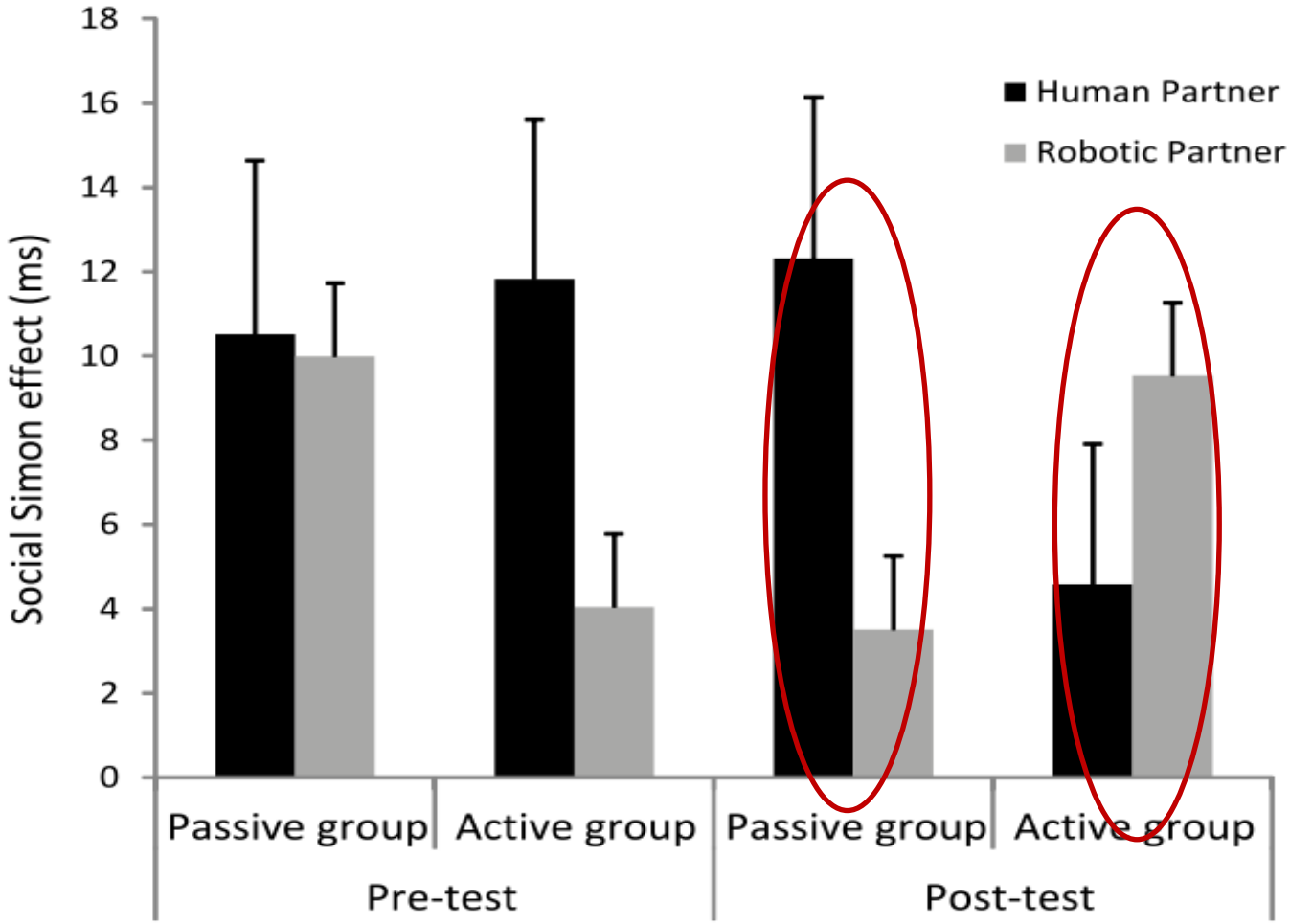


Results

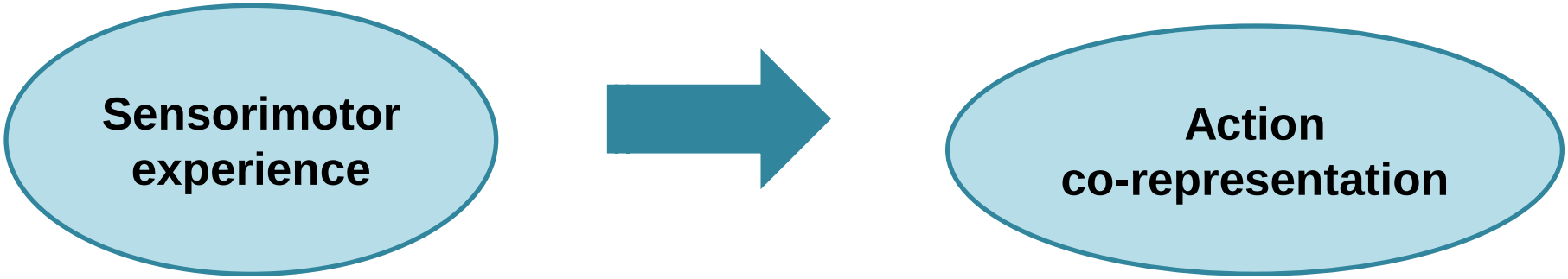
- ANOVA

-Significant Compatibility × Group × Test × Partner interaction,

***F*(1,48) = 5.33, *p* = .025**



Conclusion



✓Action co-representation is modulated by prior sensorimotor experience

✓Partner perception is modified after the active sensorimotor experience

- *Joint Simon effect may not be modulated by the origin of the partner ?*

Thank you for your attention

Collaborations

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Merci de votre attention

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