Training Motor and Social Skills in Autism with Tangible and Virtual Joint Actions: the MIMETIC project

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LIMSI-CNRS / Université Paris Saclay

Outline

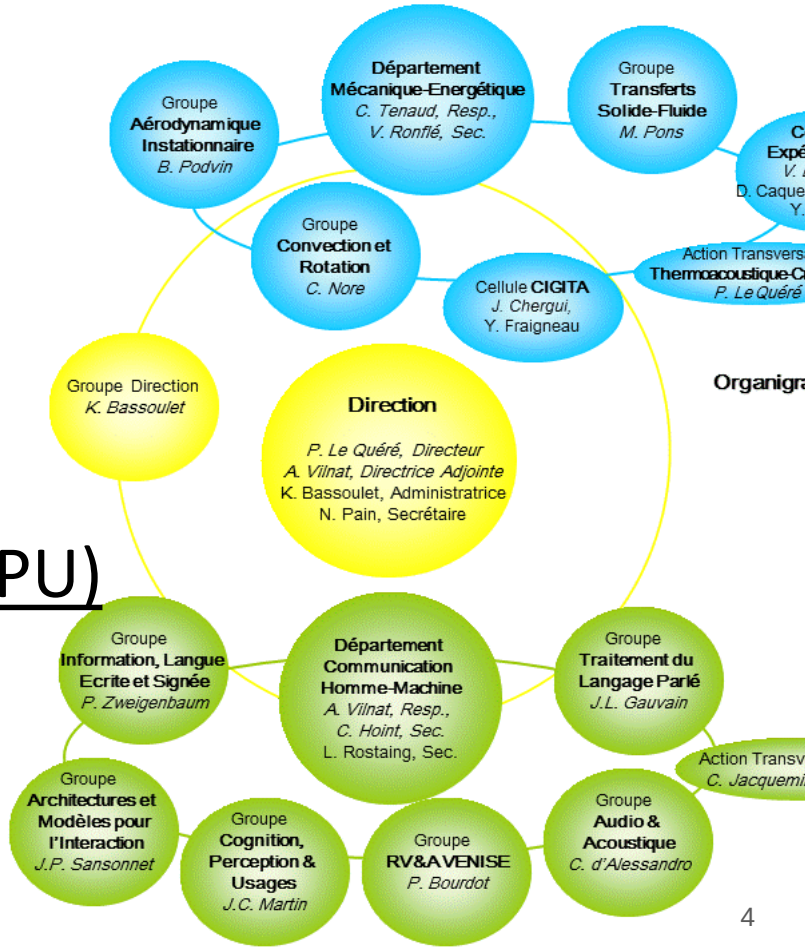
- Introduction
- Related work
- Research goals
- Current state
- Future plans

Introduction : LIMSI / CPU

LIMSI

Laboratory of Informatics for Mechanics and Engineering Sciences

- French National Research Centre (CNRS)
  - Université Paris Saclay
  - 120 permanents researchers
  - 60 PhD students
  - Created in 1972
- HCI Department
  - Cognition Perception Uses (CPU)
  - Virtual and Augmented Reality
  - Audio & Acoustics
  - Spoken Language Processing



Group
Cognition Perception Usages





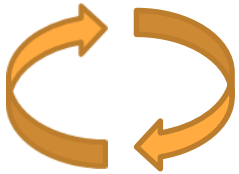


Head
J.-C. Martin

7 permanent researchers

3 Computer Science + 4 Psychology (+ Engineers)
10-15 PhD students and postdocs

Inspiring from Psychological theories for the design of HCI



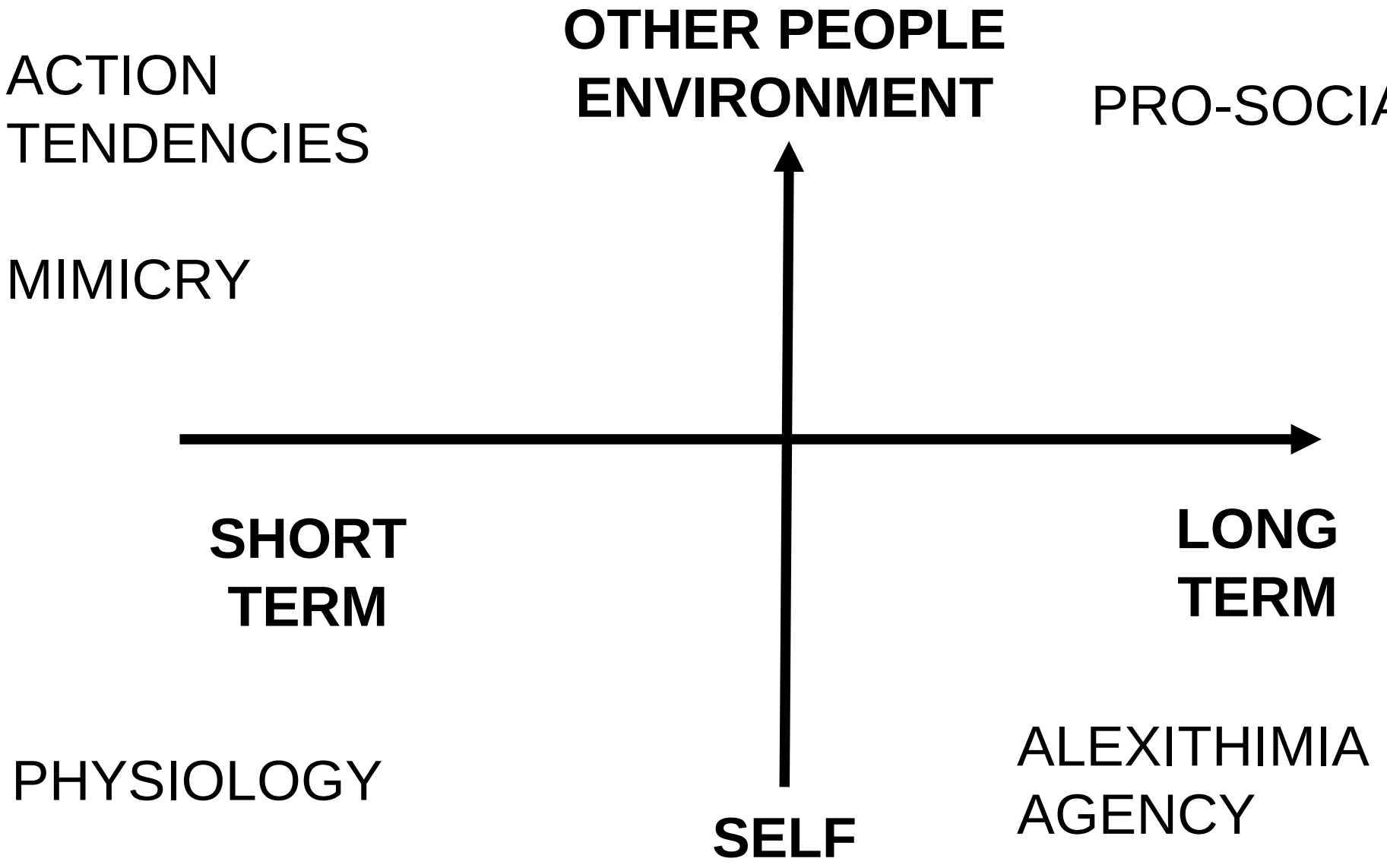
Using HCI to better understand humans

Jean-Claude MARTIN's research

- Coaching personalised
  - Personality
  - Physical exercices / nutrition
  - Backpain, diabets, obesity (hospitals)

- Training social skills
  - Virtual patients (Alzheimer, Psychiatry) hospitals
  - Team leaders (VICTEAMS)
  - Job interview & public speaking
  - Autism

2 dimensions impacting
non verbal affective interacion



Previous publications about autism

Gaze
Expressions of emotions
Virtual agents & Social robots

Grynszpan, O. Bouteiller, J., Grynszpan, S., Le Barillier, F., Martin, J.-C., Nadel, J. (2019)
Altered sense of **gaze** leading in autism.
Research in Autism Spectrum Disorders. Volume 67, 101441
[Impact Factor = 1.799]

Grynszpan, O., Martin, J.-C., Fossati, P. (2017)
Gaze Leading is Associated with Liking.
Acta Psychologica . Volume 173, February 2017, Pages 66–72
[Impact Factor 2015: 1.816]

Grynszpan, O., Nadel, J., Martin, J.-C., Fossati, P. (2017)
The Awareness of **Joint Attention**: a Study Using Gaze Contingent Avatars
Interaction Studies | Social Behaviour and Communication in Biological and Artificial Systems.
[Impact Factor = 0.535]

Chevalier, P., Martin, J.-C., Isableu, B., Bazile, C., Tapus, A. (2016).
Impact of **Sensory Preferences** of Individuals with Autism on the Recognition of Emotions Expressed by Two **Robots**, an Avatar, and a Human.
Journal Autonomous Robots · May 2016. · DOI: 10.1007/s10514-016-9575-z
[Impact Factor = 2.07]

Courgeon, M., Rautureau, G., Martin, J.-C., Grynszpan, O. (2014)
Joint Attention Simulation using Eye-Tracking and Virtual Humans.
IEEE TAC (Transactions on Affective Computing)
Issue 3 - July-Sept. (vol. 5), pp. 238-250
[Impact Factor = 3.466]

Grynszpan, O., Simonin, J., Martin, J.C., Nadel, J. (2012)
Investigating **social gaze** as an action-perception online performance.
Frontiers in Human Neuroscience, 6, 1-8, doi: 10.3389/fnhum.2012.00094,
http://www.frontiersin.org/Human_Neuroscience/10.3389/fnhum.2012.00094/abstract
[Impact Factor = 2,9]

Grynszpan, O., Nadel, J., Martin, J. C., Simonin, J., Bailleul, P., Wang, Y., Gepner, D., Le Barillier, F., Constant, J. (2012).
Self-monitoring of gaze in high functioning autism.
Journal of Autism and Developmental Disorders (JADD), 42 (8), 1642-1650. doi: 10.1007/s10803-011-1404-9
[Impact Factor = 3,723]

O. Grynszpan, J. Nadel, J. Constant, F. Le Barillier, N. Carbonell, J. Simonin, J-C. Martin, M. Courgeon (2011)
A new virtual environment paradigm for high functioning autism intended to help attentional disengagement in a social context.
Journal Of Physical Therapy Education, vol 25(1), pp 42-47

Grynszpan, O., Martin, J.-C., Nadel J. (2008)
Multimedia interfaces for users with high functioning autism: an empirical investigation.
International Journal of Human – Computer Studies (IJHCS), 66, 628-639
[Impact Factor = 1.415]

Grynszpan, O., Martin, J.-C., Nadel J. (2007)
Exploring the Influence of Task Assignment and Output Modalities on Computerized training for Autism.
Interaction Studies, 8 (2), 241-266.

MIMETIC: Introduction

What is a joint action?

MIMETIC Partners

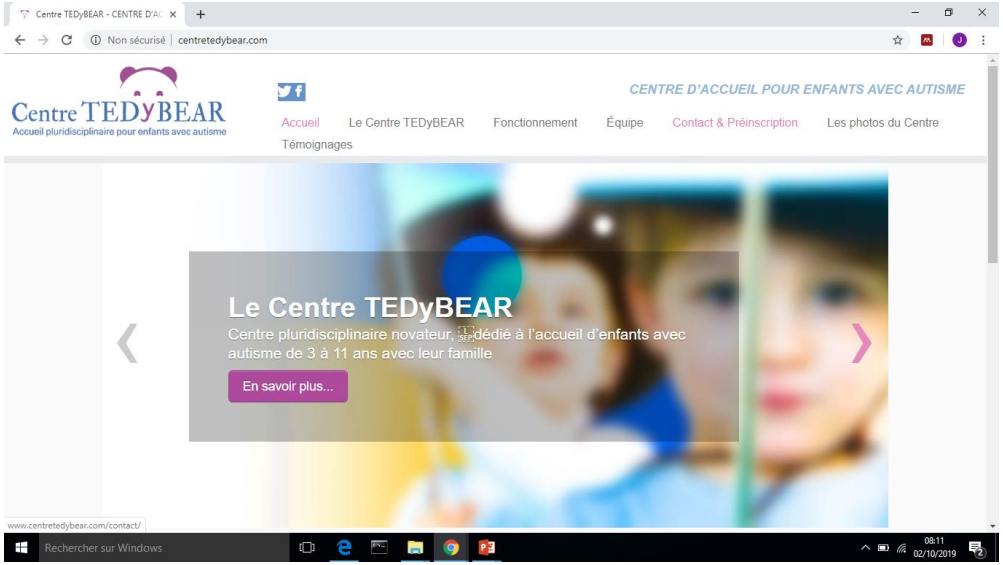
- MIMETIC:
  Motricity autIsM tangiblE and virTual joInt aCtion
- Coordinator : Jean-Claude MARTIN

- LIMSI-CNRS :
  Tom GIRAUD, Brian RAVENET, Elise PRIGENT

- TEDyBEAR :
  Jacqueline NADEL, Gaël POLI

TEDyBEAR

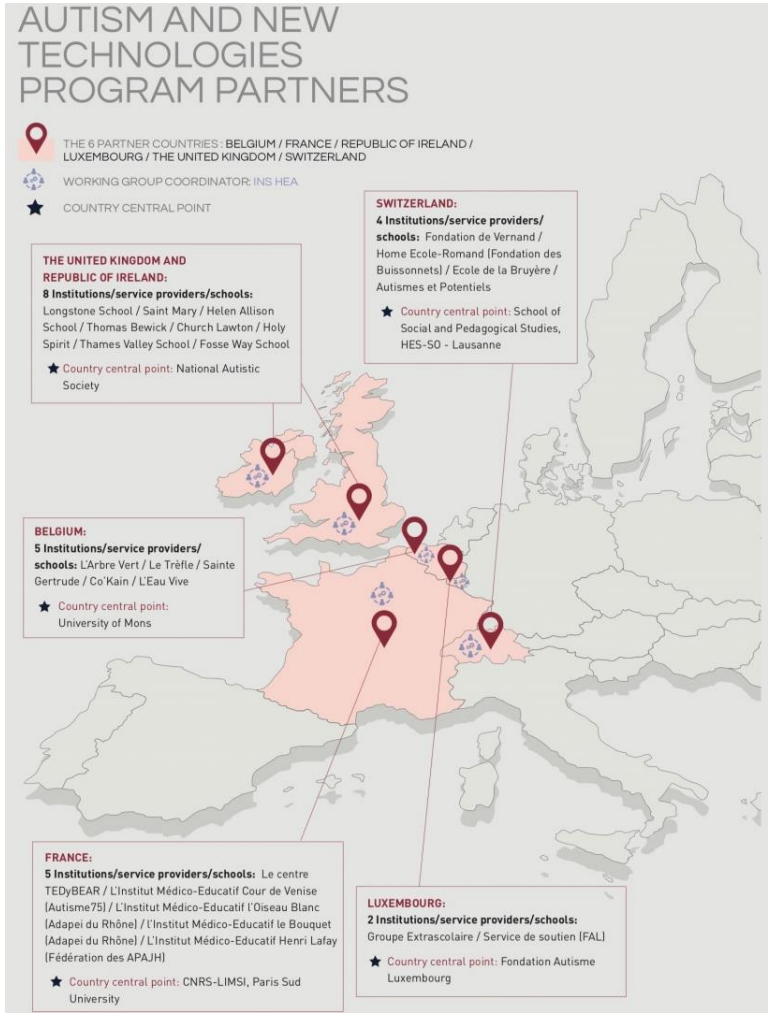
- Day care center
- 2 locations in Paris
- 30 children with autism
- mental impairment
- Kinect sessions
- J. Nadel



MIMETIC Funding

FIRAH
RECHERCHE APPLIQUÉE SUR LE HANDICAP
APPLIED DISABILITY RESEARCH

- FIRAH: International Foundation of Applied Disability Research
- Founded in 2009 and state-approved
- Dedicated to applied disability research.
- Main activities
  - Annual calls for projects to select and finance innovative projects
  - Resource Center (which develops, disseminates and promotes applied research findings)
- Funding Program on “Autism and new technologies”



A program coordinated by:

FIRAH
RECHERCHE APPLIQUÉE SUR LE HANDICAP
APPLIED DISABILITY RESEARCH

Main funder:

UEFA FOUNDATION for children

Co-funder of the research axis:

Fondation orange

In partnership with:

Autism Europe aisbl

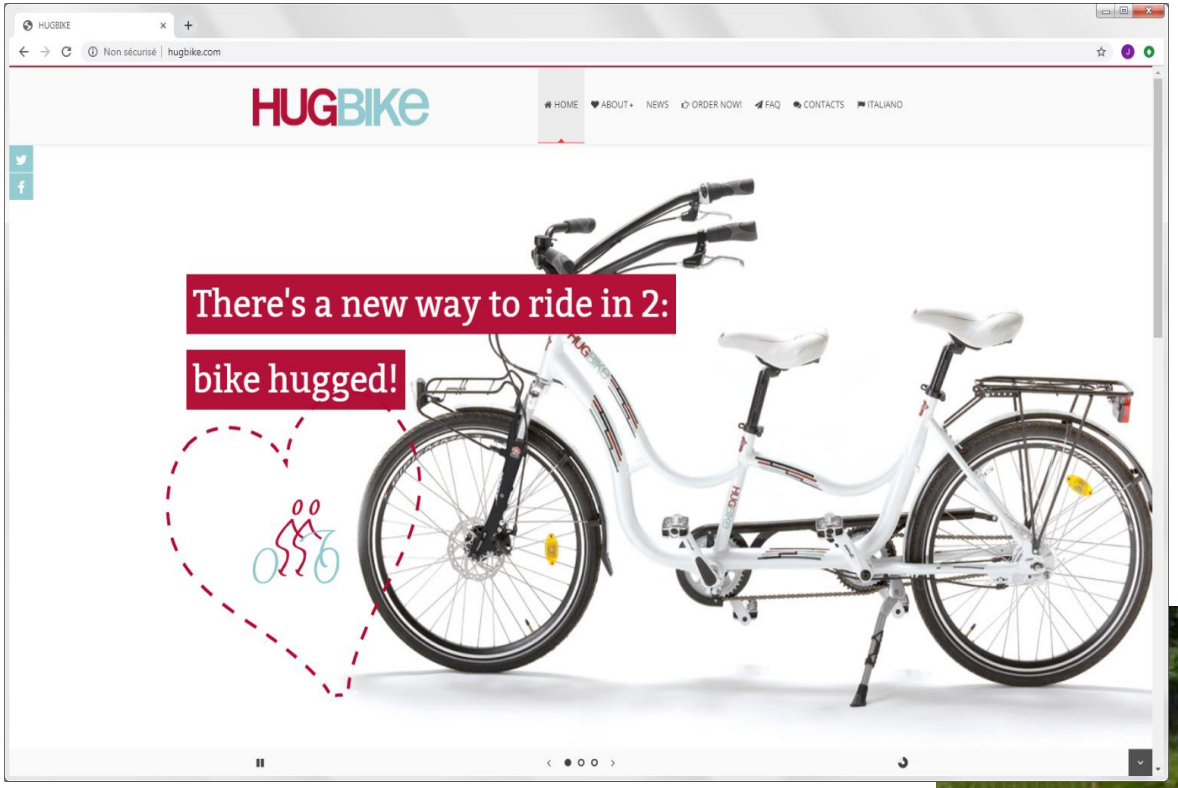
MIMETIC Research Goals

- Help children with ASD develop
  their motor and social skills
  in order to encourage children's participation
  in sports, school and daily activities within family

- Develop a virtual training software
  requiring the use of collaborative motor skills

- Assess its capacity
  to improve both motor and social skills of autistic people

Joint action in everyday life



Related Work

Information Technologies for Autism

- State of the art surveys

ELSEVIER

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Serious games to teach social interactions and emotions to individuals with autism spectrum disorders (ASD)

Charline Grossard [a], Ouriel Grynspan [b], Sylvie Serret [c], Anne-Lise Jouen [b], Kevin Bailly [b], David Cohen [a, b, *]

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[b] Institut des Systèmes Intelligents et Robotiques, CNRS UMR 7222, Sorbonne Universités, Université Pierre et Marie Curie, 1 Place Jussieu, 75005, Paris, France
[c] Department of Child and Adolescent Psychiatry et Centre de Ressource Autisme, Université de Nice, Fondation Lenval, 57 Avenue de la Californie, 06200, Nice, France

Joint action definitions

- (Brinck 2017)
  - A joint action is such that could not have been brought about by a single agent, nor by a group of agents acting individually or in parallel.
  - Jointness implies that an action is done together in the sense that
    - each agent has the intention to perform the action in question,
      each acts so as to contribute to achieving the action,
      and each adjusts his or her individual contributions to those of the other agents to successfully perform the action with the others.
  - An additional condition is that the agents share the goal of the action.
- …

Consciousness and Cognition 75 (2019) 102820

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Consciousness and Cognition

journal homepage: www.elsevier.com/locate/concog

The sense of agency in human-human vs human-robot joint action

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ABSTRACT

Kinesthesis pertains to the perception of moving body parts, while the sense of agency refers to the experience of controlling one's action-effects. Based on previous work, we hypothesized that the sense of agency would decrease in joint action with a robot compared to a human partner. Pairs of participants were jointly manipulating two interconnected haptic devices enabling them to feel each other's forces. Unbeknown to participants, their partner was sometimes replaced by a robot. The sense of agency was assessed using intentional binding, which refers to a contraction of perceived time between an action and its effect for intentional actions, and participants' judgment of their contribution to joint action. Participants judged their contribution as higher when they were initiating action and when they were paired with the robot. By contrast, intentional binding occurred only with a human partner. This outcome supports the hypothesis that human-robot joint action hinders intentional binding.

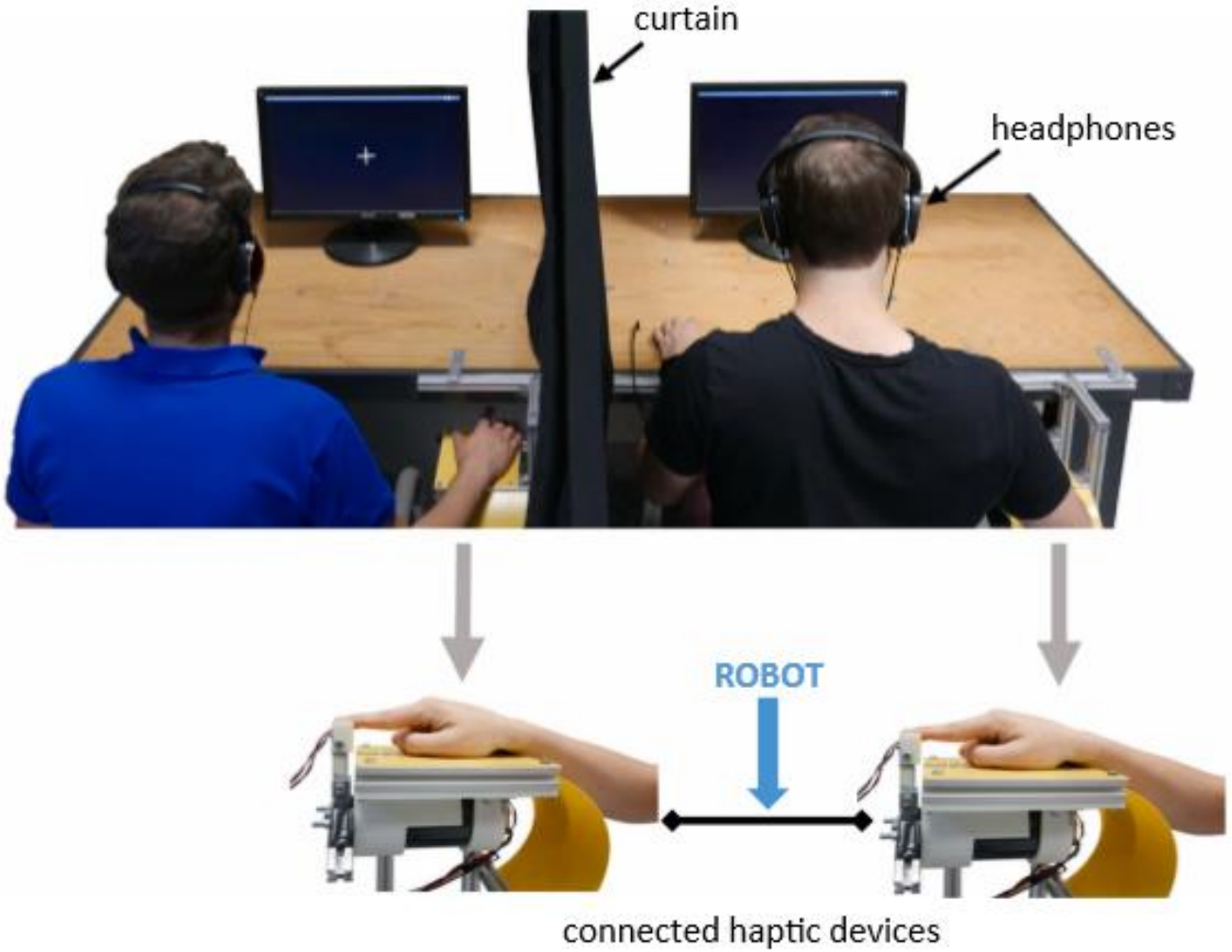

Fig. 1. The experimental setup: Two participants were sitting side by side, separated by a curtain and wearing noise-cancelling headphones. They were manipulating handle haptic devices with their index finger. Each handle could either reproduce the forces applied by their partner on the other handle or be controlled by a robot. Movement and force data were collected by the device.

Joint action with a virtual robotic vs. human agent

Accepted Manuscript

Joint action with a virtual robotic vs. human agent

Frédérique Bunlon, Jean-Pierre Gazeau, Floren Colloud, Peter J. Marshall, Cédric A. Bouquet

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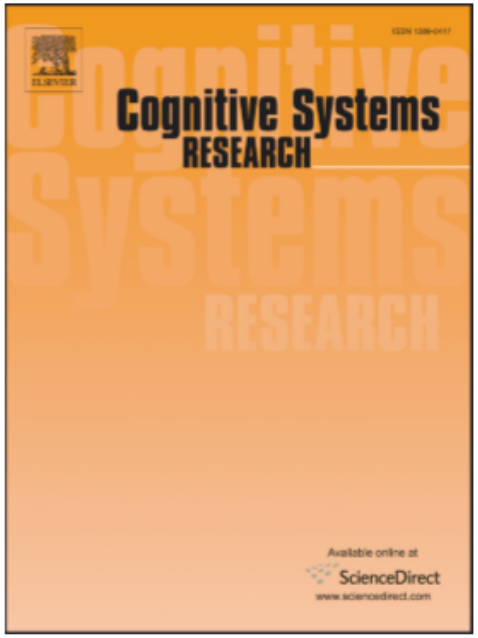


Joint action with a virtual robotic vs. human agent

Prior research has revealed that when performing joint action tasks with a human co-actor, we automatically form representations not only of our own action, but also of the action of the co-actor we are interacting with, creating an action discrimination problem. Studies suggest these processes are affected by the human/non-human nature of the agent the task is shared with. In two experiments (Experiments 1 and 2), we measured the Joint Simon Effect (JSE) as an index of action discrimination, using a virtual version of the joint go/no-go task in which the task was shared with a virtual robotic vs. human hand. Furthermore, both experiments tested whether the JSE was affected by sensorimotor experience during which the participant manipulated the virtual robotic hand via an exoskeleton (vs. passive observation of movements of the virtual robotic hand). Experiment 2 replicated Experiment 1, except that prior to the joint action task, participants were informed about the robotic vs. human nature of the two virtual hands (no such information was given in Experiment 1). Both experiments demonstrated a significant JSE, which did not differ between robotic and human partner. Analysis of the results further indicates that the JSE obtained in the robotic condition was not modified after manipulating the virtual robotic hand. These results suggest that the human vs. non-human appearance of the partner is not a determinant of joint action performance in virtual settings.

Related Work

8th Joint Action Meeting

Join us in Genova, July 10 – 13, 2019!

In collaboration with Central European University and Fondazione Istituto Italiano di Tecnologia, we are glad to announce the eighth edition of Joint Action Meeting (JAM VIII), to be held in Genova, Italy, from Wednesday 10th to Saturday 13th July, 2019.

Human life is full of joint actions, ranging from a handshake to the performance of a symphony. We are highly skilled at coordinating our actions with those of others to reach common goals, and rely on this ability throughout our daily lives. What are the cognitive and neural processes underlying this ability? How does joint action develop? How do language and gesture support and emerge from joint action? What are the basic principles needed to build robotic systems that can interact with humans? What does differentiate joint action from individual action, both conceptually and in terms of experience?

The scientific program will comprise oral presentations and posters addressing these and related questions. Contributions will present the latest research and thinking on a range of different topics, including language as a form of joint action, the interplay of perception and action in joint action, and the phylogenetic, ontogenetic, and cultural foundations of joint action.

Goals

- Avoid **complex representations** which are too difficult for children with mental deficiencies

- Start from the **motor** level
  rather than from the social level itself
  to develop the social level

MIMETIC

Hypothesis:

A motor dialog with another person
(eg caring a heavy object together)
increases the interest in the other since the child has to consider his/her movement

Joint action as a basis for social exchanges and insertion in life context is stimulated by the virtual / tangible device

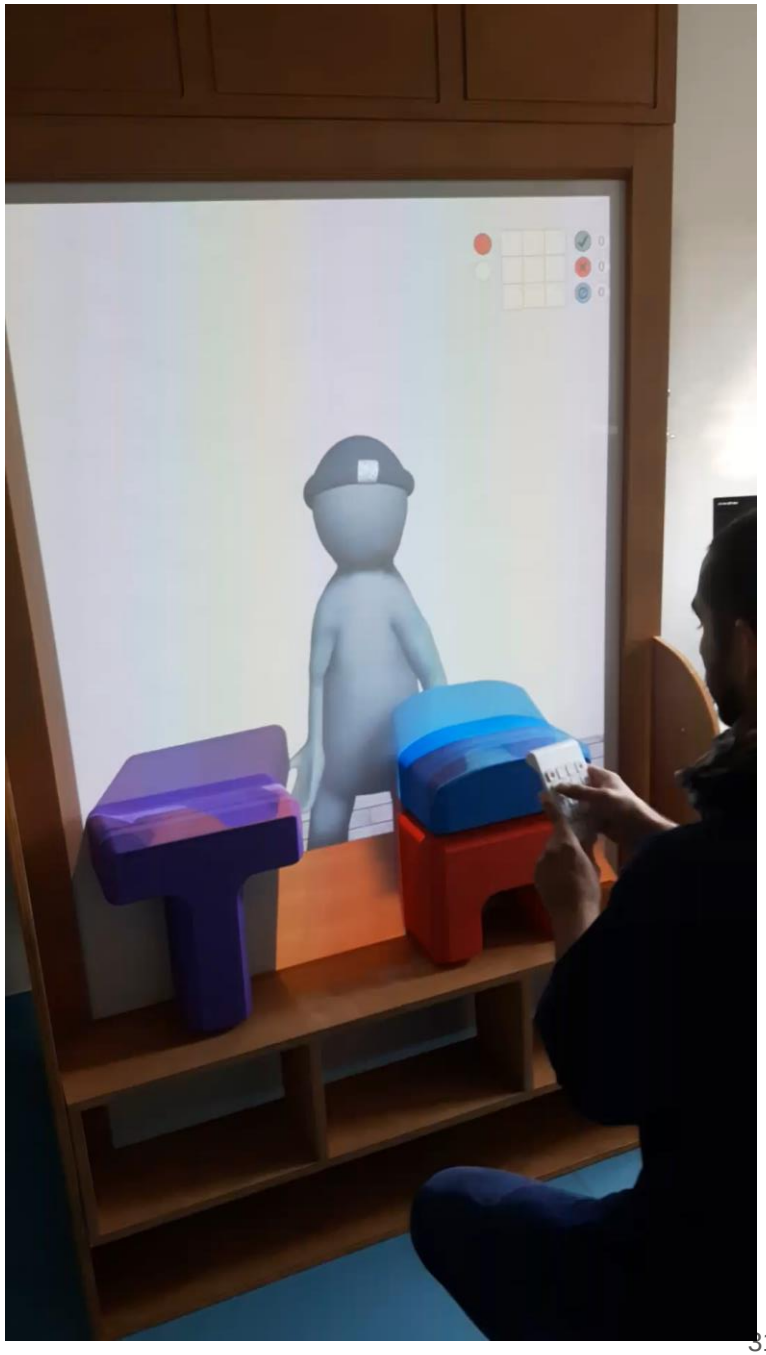
Progressive training

- Watching video of some interactions with MIMETIC
- Interacting with an helping character which follows the child’s movement
- Interacting with an autonomous character which has its own goal
- Joint action with another child

MIMETIC installed at TEDyBEAR

MIMETIC
installed at TEDyBEAR

« Help Michou put the blue box on the purple table »



Support for research questions

- What is a joint action?
  - According to researchers
  - According to a child with autism
  - According to the virtual character
- How to assess the quality of a joint action?
- Quality / continuity of tangible and virtual continuum?

Future directions

- Evaluation
  - TEDyBEAR (+ joint action with peer)
    Augsburg
    Paris Cour de Venise (teenagers)
- Improvements and extensions
  - Force feedback
  - User’s behaviors and interaction
  - Other applications