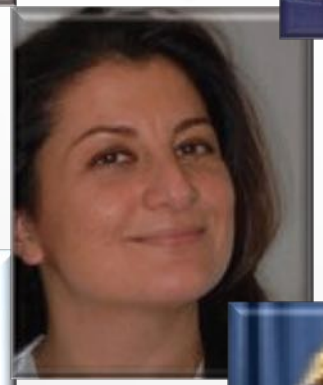
MeeTo 2018: from moving bodies to interactive minds
Turin, May 25 – 27, 2018












MEMORY SLICES



Anna Strasser
2018

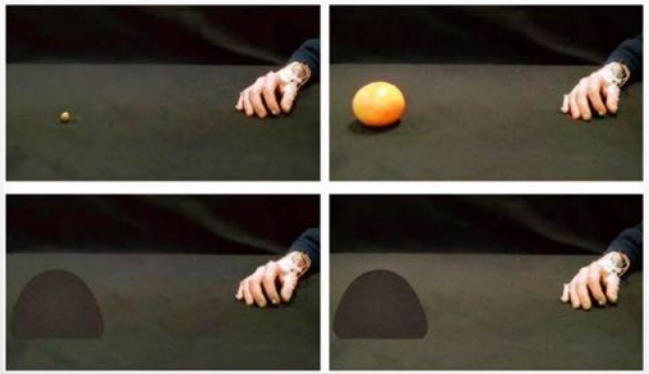





Keynote Lecture I – Cristina Becchio:
Seeing Mental states: an empirical approach

- Are intentions visible in other's action? What degree of visual presence?
  → movement kinematics convey intention information

implicit
social cues



→ PREDICTION OF THE SIZE OF OBJECT WITHOUT SEEING IT

What about robots?

hard to read for robots and robots are hard to be read

https://www.iit.it/research/lines/social-cognition-in-human-robot-interaction

BACKGROUND: I.MOVE.U – INTENTION FROM MOVEMENT UNDERSTANDING

From moving bodies to interactive minds - study of intention understanding

observing other's movements → inferences about unobservable mental states

- intentions are extracted from body motion during interaction with conspecifics
  - ? deceive other about the real weight of a lifted box / ? throw a ball or mimic a throw / ? movements performed with the intent to cooperate or compete

❖ knowledge of other minds is linked to our interactions with others & investigating individual minds in isolation fails to capture processes and mechanisms supporting interpersonal understanding

→ **availability in interactions:** mental state dispositions can become visually available when they enter into interaction with mechanical and anatomical features to generate the kinematics of a given action

PREDICTING IS ESSENTIAL FOR INTERACTIONS

(ONLY REACTING DOES NOT ENABLE FAST & SMOOTH COORDINATION NEEDED TO INTERACT)

Symposium I - Annalisa Bosco (convener), Alessandro Benedetto, Silvio P. Sabatini, Vittorio Sanguineti:

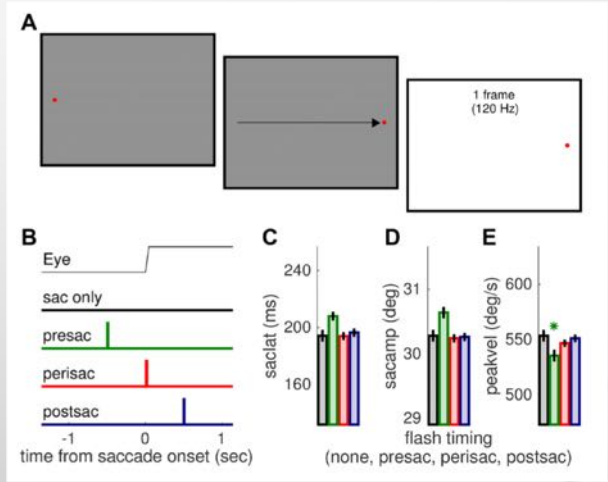
Shaping the understanding of the world through action.

ALESSANDRO BENEDETTO: ACTIVE VISION: SACCADIC EYE MOVEMENT

- pupillary response to light flashes: robust suppression during saccades
  (features deviate in interesting ways from the suppression of conscious vision)
  - no flash: mere execution of a saccade is sufficient to generate a pupillary modulation
    → responses to flashes reflect the combination of two pupil responses, related to light & to the saccade

INTEGRATING DIVERSE SOURCES OF INFORMATION → COMPLEXITY OF PUPILLARY RESPONSES

idea: saccades may produce different effects on visual pathways supporting conscious perception and those supporting other visual functions



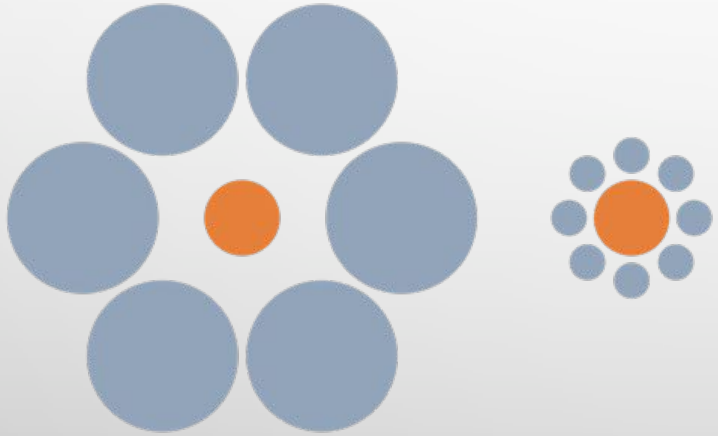
http://win.pisavisionlab.org/PDF_Publications_PisaVisionlab/Alessandro_Benedetto_Publications/benedetto2016.pdf

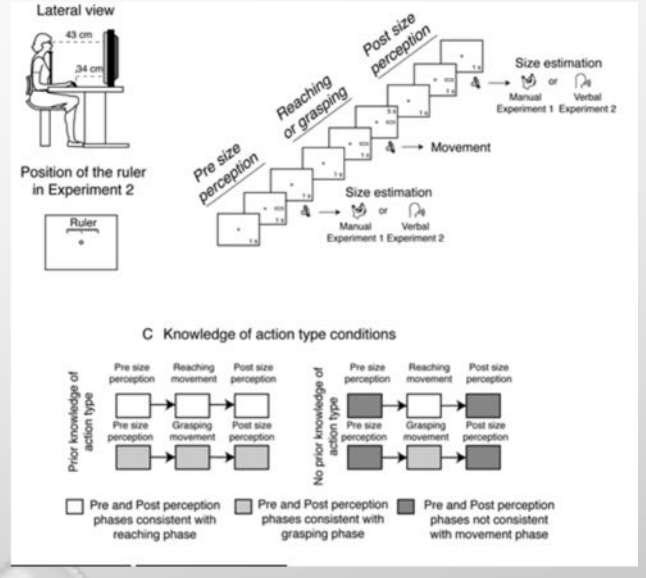
ANNALISA BOSCO: The motor experience and its context influence object perception

SIZE CONTRAST (SIZE-WEIGHT ILLUSION)

- Does 'type of action' executed influence the object size perception? (*reach versus grasp*)
- Does 'prior knowledge of action type' influences the object size perception?

Bosco, A., Daniele, F., Fattori, P. (2017). Reaching and grasping actions and their context shape the perception of object size, *Journal of vision*, 17, pp.10-29





http://jov.arvojournals.org/article.aspx?articleid=2659354

University of Bologna

ANTONELLA MASELLI: Whole-body throwing kinematics cues provide information on ball trajectory and individual throwing style

PREDICTING INTENTIONS & OUTCOME OF OBSERVED ACTIONS IS IMPORTANT FOR SUCCESSFUL INTERACTIONS

cv7
Head
Hand
Wrist
Elbow
Should
Pelvis
Knee
Ankle
Foot

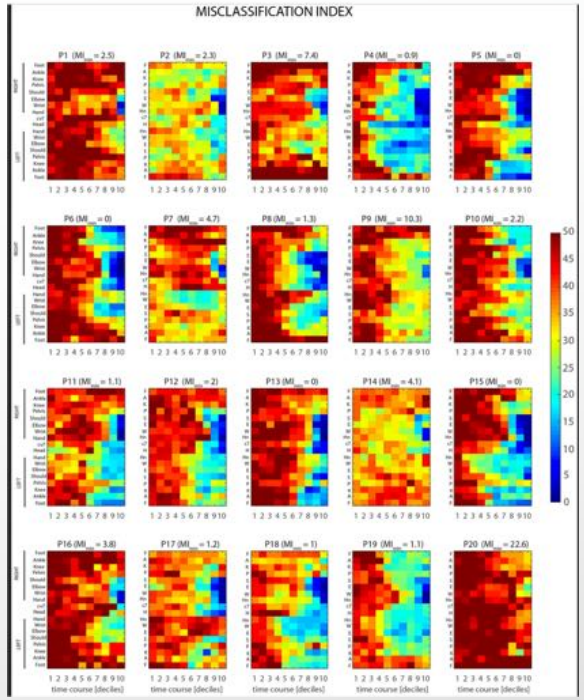
Can we predict the ball trajectory?

- interactive throwing-and-catching tasks

  →explore nature of early whole-body kinematics cues

RESULTS: predictions of ball direction 400ms before ball release (with an accuracy above 80%)

→early predictions (more than 200ms before)
associated to body parts other than the throwing arm



INTERPRETATION: IDEAL CATCHER (HUMAN OR ROBOT) COULD EXPLOIT PRIOR KNOWLEDGE ABOUT THE MOST INFORMATIVE BODY PARTS, AND OF THEIR DEPENDENCE ON THE TEMPORAL COURSE OF THE THROWING ACTION

Laboratory of Neuromotor Physiology, IRCCS Santa Lucia Foundation, Roma

https://www.frontiersin.org/articles/10.3389/fnhum.2017.00505/full

JAMES P. TRUJILLO: Action expectation & social processing: brain activation in response to communicatively exaggerated kinematics

USING GESTURES IN COMMUNICATION

- IF communicative → observers recognize exaggerate kinematics of movements → infer social intention

participant responses + pantomime kinematics → model the "communicativeness" of kinematic exaggeration

? Does "communicativeness" modulate activity in pMNS and MS brain regions?

interaction between premotor (*putative mirror neuron* pMNS) & medial prefrontal cortex (*mentalizing systems* MS)

RESULTS:

- communicative: both regions responded to communicative exaggeration
    - decreased pMNS influence (directional connectivity) on the MS,
    - but increased MS influence on the pMNS
- non-communicative: only pMNS responded to communicative exaggeration

https://www.ru.nl/mlc/@1141841/new-publication-james-trujillo/

Trujillo, J. P., Simanova, I., Bekkering, H., & Ozyurek, A. (in press).
Communicative intent modulates production and perception of actions and gestures: A Kinect study. Cognition.

Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, The Netherlands Centre for Language Studies, Radboud University Nijmegen, The Netherlands

KATRINA L. MCDONOUGH: From moving bodies to distorted minds: expectations of action bias social perception

Plymouth University, UK

ACTION UNDERSTANDING

- problems with this bottom-up approach
- top-down process?

<u>experiment about efficient actions</u>

- if obstacle around the straight action is inefficient

	efficient	inefficient
Obstacle there	OVER	Straight action
No obstacle	Straight action	OVER

CLAUDIA GIANELLI – On grasping and being grasped: processing active and passive language in the motor system

University of Potsdam, Germany

SENSORIMOTOR PROCESSES TAKE PLACE IN OUR BRAINS WHILE WE OBSERVE ACTIONS PERFORMED BY OTHERS

- motor resonance detectable during language comprehension both with and without a concurrent motor task → Impact of active and passive form of action-related sentences to motor responses *(comparing hearing "You grasped the ball" with reading "The ball was grasped by you"?)*
- measuring:
  - (1) reaction times, movement times and accuracy rates in behavioral task
  - (2) EEG effects on cortical oscillations.
- RESULTS: comparable motor effects

LUIGI F. CUTURI: The triangle completion task in children: the development of spatial updating across age

MOTOR SKILLS & RELATIONSHIP WITH ALLOCENTRIC REPRESENTATION OF SPACE

- **triangle completion task**
  - 40 blindfolded children were walked along the first two segments guided by the experimenter
  - then subjects were asked to go back to the start position without support

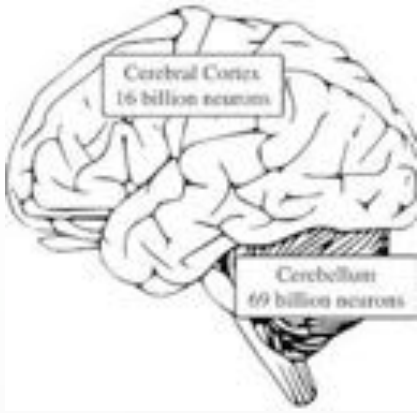
RESULTS: younger children have a performance worse than older peers

→ influence of the developmental stage in understanding the turned angle

  - indexes as the distance between the ending point of the trajectory and how stable children maintain a straight heading while moving (i.e. directness), show that performance improves later in development (age 9-11 y.o.).

- By unveiling the changes of spatial updating across development, this work provides the scientific basis for the development of technological platforms that could teach how to discriminate angles of different apertures by walking.

FRANK VAN OVERWALLE: THE SOCIAL CEREBELLUM



CEREBELLUM: MOTOR FUNCTIONS + SOCIAL FUNCTION (BODY READING, MINDREADING)

- →meta-analysis Van Overwalle et al. (2015):
  activation in the cerebellum in about one third of 350 fMRI studies on social cognition
  - unique cerebro-cerebellar links between mentalizing / sensorimotor networks of the cerebellum and the cerebrum during social reasoning tasks

<u>typical cerebellar capacity:</u>

- execute & automatize smooth sequences of one's motions, allowed humans to understand, automatize & generate -- in their mind -- action sequences of the behaviors of others → **requirement to understand actions & emotions of others**
- tested cerebellar patients:

  - generating of the correct order of social actions depicted in cartoons containing elements of false beliefs (Langdon & Coltheart, 1999) showed significant differences with healthy matched controls, while ordinary (overlearned) actions and mechanical sequences did not reveal differences

GIUSY OLIVITO: Spinocerebellar ataxia type 2 as model to investigate the cerebellar role in social cognition: understanding the cerebellar contribution to autistic-like symptoms

- SCA2 cerebellar patients: **spinocerebellar ataxia type 2**
- pathological changes in cerebellar gray matter (GM) and the main cerebellar white matter (WM) microstructure → reduced theory-of-mind abilities to correlate with these alteration patterns.

CHIARA FERRARI: TMS over the cerebellum interferes with explicit and incidental processing of facial emotional expressions

role of the cerebellum in emotion perception and recognition, using transcranial magnetic stimulation (TMS).

RESULTS: TMS over the (left) cerebellum
→ impaired ability to categorize facial emotional expressions (explicit emotion perception)
& ability to classify the gender of emotional faces (incidental emotional processing)

IRCCS Santa Lucia Foundation, Rome

University of Milano-Bicocca

NATALIE SEBANZ - *Self and other as a unit: the "we" in joint action planning and coordination*

relation of **intention** (*shared intention → Bratman 2014*)

relation of action plans and predictive models

relation of **movement** (*coupled oscillators forming a single systems – no mental states*)

JOINT ACTION PLANNING

- How do you plans specify relations between actions? Do people specify relations between actions even when there is nothing else (no individual plans)?
    1. What kind of information in mutually coupled action prediction – reducing the number of possibility (Konvalinka 2011 tapping … reciprocal effect more synchronized if both hear the other)
    2. mirror game (reciprocal predictions) – perfectly align if there is no leader / follower > both predicting each other – leader follow / congruent incongruent conditions
    3. joint action coordination reciprocal is not always better!
    4. joint action perception

SHAHEED AZAAD: SOCIAL MODULATION OF AFFORDANCES: TASK SHARING JOINT AFFORDANCES IN A BIMANUAL AFFORDANCE TASK

Melbourne School of Psychological Sciences

***AFFORDANCES* = SET OF POSSIBLE ACTIONS AN ENVIRONMENT PROVIDES FOR AN INDIVIDUAL** (Gibson1979)

- How co-action modulates the perception of affordances?
  - **engaging in co-action influences our perception & cognition**

STUDY task-sharing paradigm (Sebanz, Knoblich & Prinz, 2003)

- joint go/no-go task → keypress responses with the hand correspondent with their seating position while their non-responding hand was tied to their leg. Image colours (red, blue, yellow) cued one of three response options: participant A go/participant B no-go; participant B go/ participant A no-go; participant A and B go (joint trials).
- RESULT: 2(Response: individual vs joint) x 2(Affordance: unimanual vs bimanual) interaction effect on response times → relative facilitation of joint trial response times for bimanual objects. → acting with a social partner creates a shared grasping affordance – effectively distributing the bimanuality of response across dyads

unimanual grasp-affording objects

bimanual grasp-affording objects

LUCIA MARIA SACHELI: Behavioural and neurophysiological evidence for a dyadic motor plan in joint action

WHAT MECHANISMS DISTINGUISH INTERACTIVE FROM NON-INTERACTIVE ACTIONS?

→ NO DYADIC PLAN IN NON-INTERACTIVE ACTIONS!!!

<u>interactive joint action condition</u>
playing a melody together by grasping or pressing a cube-shaped instrument
I KNOW WHAT I HAVE TO DO + WHAT THE PARTNER HAS TO DO

<u>non-interactive control condition</u>
behavior was not guided by a shared melody (→ partner's actions were irrelevant)
I ONLY KNOW WHAT I HAVE TO DO

both conditions: actions were physically congruent (e.g., grasp-grasp) or incongruent (e.g., grasp-point), and the partner's association between actions and notes was coherent with the participant's or reversed

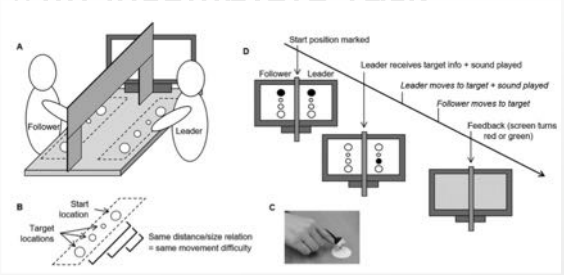
RESULTS:

- non-interactive condition: only affected by physical incongruence of movements
- joint action: only affected when the partner's action-note associations were reversed
  - same experimental paradigm to fMRI: task interactivity shapes the sensorimotor coding of others' behaviors →joint action based on active prediction of the partner's action goals and effects rather than on passive action imitation

CORDULA VESPER:
Modulating action duration to establish non-conventional communication

INTERPERSONAL COORDINATION

IF knowledge is distributed asymmetrically THEN persons modulate basic parameters of goal-directed actions in a way that provides relevant information to the co-actor with incomplete task knowledge



- sensorimotor communication (*spatial parameters like movement amplitude*)

HERE **temporal parameters**

- 3 STUDIES: systematic modulations of action duration provide a basis for communication

RESULTS:

- knowledgeable actors spontaneously & systematically adjust duration of actions to communicate task-relevant information / clearer communicative signal →higher benefit for the co-actor's performance
- knowledgeable actors have a preference to separate instrumental from communicative aspects of their action

→ GENERATING & PERCEIVING SYSTEMATIC DEVIATIONS FROM THE PREDICTED DURATION OF A GOAL-DIRECTED ACTION CAN ESTABLISH NON-CONVENTIONALIZED FORMS OF COMMUNICATION DURING JOINT ACTION

https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxjb3JkdWxhdmVzcGVyfGd4Ojc3NjUxZDdhM2Q0N2Q1Zml

DIMITRIOS KOURTIS:

Observation of communicative cues makes human interaction more meaningful: evidence from EEG

mutual eye gaze	*1st photo: 2 actors directed their eye gaze towards each other's eyes, but in 50% of the trials the recipient had eyes closed*
perception of pointing	*2nd photo: communicator pointed & looked at one object, while recipient either perceived the pointing gesture (50% of the trials) or had eyes closed*
joint attention	*3rd photo: communicator kept looking at the same object & recipient either looked at that object (i.e. shared focus of attention in 50% of the trials) or looked at the other object*

Does observation of communicative cues between 2 agents makes subsequent interaction that involves attending to the same or to different objects more meaningful to the observer?

- **N300 smaller** when actors shared focus of attention (**more expected** interaction outcome) → identification & categorization of actor-objects relationships is a relative fast process
- **N400 smaller** when the final photo had been preceded by mutual eye gaze or by perception of the pointing gesture

→ **PERCEPTION OF COMMUNICATIVE CUES "OPENS UP" THE MIND OF AN OBSERVER TO DIFFERENT ACTION POSSIBILITIES, ENABLING HIM/HER TO ASSIGN MEANING TO TYPICALLY UNEXPECTED INTERACTION OUTCOMES**

Psychology, Faculty of Natural Sciences, University of Stirling

FRANK T. J. M. ZAAL: Emergent coordination in joint interception

PEOPLE SHOW COORDINATED BEHAVIOUR TO ATTAIN A SHARED GOAL.

- "doubles-pong" task:
  clear division of labor with a boundary between interception domains but also some overlap
- division of labor emerges
  - from the continuous visual coupling of the player-controlled paddles and the ball. That is to say, on many trials both players initiated a movement, which was aborted by one player when the other player was on an interception course, specified through the changing triangular relation among ball and paddles.
  - Rather than being based on a tacit shared understanding of a boundary between interception domains,

boundary emerges from the unfolding dynamics of the player-player-ball system

ARIANNA CURIONI: Joint goal representation in infants: a fNIRS study

INFANTS' GOAL ATTRIBUTION IS RESTRICTED TO ACTIONS THAT ARE EFFICIENT

Why do infants not attribute nor predict agents' future goals if agents taking unnecessary detours towards a target?

- BUT adult studies of joint actions: trajectories detouring from the optimal path can have a communicative function, serving the joint goal of coordination (Candidi et al. 2015)
- **Can 9-month-olds perceive individually inefficient actions as goal-directed, if these actions are performed in the context of two agents coordinating towards a common goal?**

RESULT:

- release from suppression in the right superior temporal sulcus when infants observed two agents coordinating towards a new goal, and repetition suppression when the goal was repeated

→ infants attributed a joint goal to the agents despite both agents' actions being individually inefficient

→ indicating that infants may represent joint actions differently to the sum of individual actions, and that perceptual cues to cooperation may **override efficiency** when infants process social goals.

Central European University, Department of Cognitive Science

MICHELA CANDINI: When social and action space diverge: A study in children with autism spectrum disorders

ACTION SPACE (*PERIPERSONAL SPACE*) := SPACE AROUND THE BODY - CAN BE EXTENDED BY TOOL-USE

SOCIAL SPACE: INTERPERSONAL SPACE (*IN WHICH THE INTERACTIONS WITH OTHERS OCCUR*) - CAN BE REDUCED FOLLOWING A SOCIAL INTERACTION

- children with autism (ASD): interpersonal space is larger and less plastic

Does autism affects the regulation of the space around the body as a whole or, alternatively, it selectively affects interpersonal but not peripersonal space?

- before and after a cooperative tool-use training: Reaching- and Comfort-distance tasks to assess peripersonal and interpersonal spaces
  - in TD : cooperative tool-use training → extension of peripersonal space + selective reduction of interpersonal space with the confederate
  - in ASD : cooperative tool-use training → extension of peripersonal space BUT interpersonal space failed to change after training

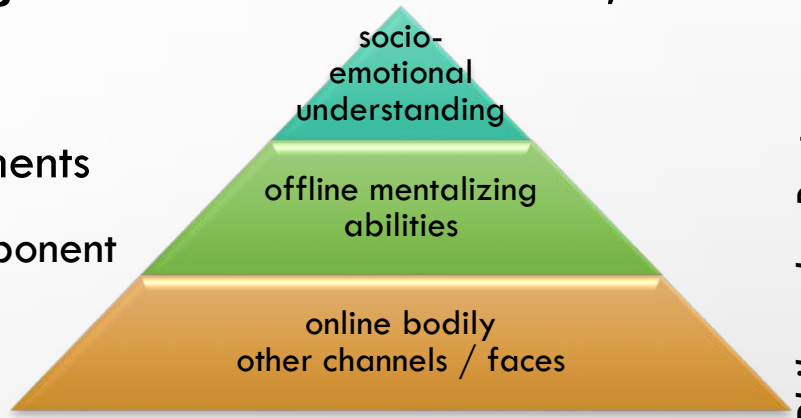
RESULT: functional dissociation between action & social spaces + a deficit confined to social space regulation in autism

Department of Psychology, University of Bologna,

ANNA CIAUNICA: The multisensory base of bodily coupling in face-to-face social interactions: contrasting the case of autism with the Mobius syndrome

"INTERACTIVE TURN" OF HOW WE UNDERSTAND OTHERS' EMOTIONS AND MENTAL STATES

What counts as foundational for socio-emotional understanding: high-level mentalistic abilities, low-level bodily coupling, or an integrative combination of both?



- crucial role of low-level bodily coupling & second-personal engagements

  Mobius Syndrome (MS) bodily facial coupling is <u>not</u> the foundational component

→ pluralistic and integrative model of interpersonal understanding

-mentalistic & embodied strategies are equally foundational

- despite the lack of automatic facial mirroring MS people benefit from other multisensory integration processing (e.g. auditory, tactile, etc.).
- contrasting MS- and autistic persons' use of compensatory strategies: ways of dealing with social impairments shed light on the constitutive and foundational role of low-level bodily coupling for socio-emotional understanding

AGNIESZKA WYKOWSKA : Uncovering mechanisms of social cognition with the use of experimental protocols involving a humanoid robot

HUMAN BRAIN ENGAGES IN VARIOUS MECHANISMS OF SOCIAL COGNITION,

E.G. ORIENTING OF ATTENTION TO WHERE OTHERS ATTEND

- experiments involving interaction with humanoid robots → excellent experimental control + introducing embodied presence of an interaction partner → increasing ecological validity
- joint attention with a gaze-cueing paradigm (iCub robot cued participants' attention by means of gaze/head direction)

  - RESULTS: gaze cueing effects were modulated both by social engagement & validity: non-predictive cueing protocol: mutual gaze resulted in larger gaze cueing effects than avoiding gaze / counter-predictive cueing: reversed pattern
  - Engagement ratings revealed that mutual gaze induced higher level of subjective engagement than avoiding gaze, independent of validity of the gaze cues.
- gaze-following paradigm with robot's gaze being contingent (or not) on participants' saccades
  → participants' return saccades to iCub's face were faster when iCub followed participants' gaze

JOINT ATTENTION IS INFLUENCED BY SEVERAL FACTORS WHICH CAN BE EXAMINED IN MORE NATURALISTIC INTERACTIVE SCENARIOS, BUT ARE OFTEN MISSED IN CLASSICAL OBSERVATIONAL EXPERIMENTAL PROTOCOLS WITH PASSIVE STIMULI PRESENTED ON THE SCREEN.

KEYNOTE: LUCIANO FADIGA: ACTION AND INTERACTION

CUES READ BY SENSORIMOTOR BRAINS

- grasp to drink versus grasp to pour / lifting light or heavy stuff / strength in the muscles if one expects an individual profit compared with the situation in which one should help the other to win…
- music example: conductors
  - journals.plos.org/plosone/article?id=10.1371/journal.pone.0035757
  - increase of conductor-to-musicians influence + reduction of musician-to-musician coordination (an index of successful leadership) goes in parallel with quality of execution, as assessed by musical experts' judgments

- convergence during speech
  - mirror in the scanner seeing real eyes not just pictures!

Friths: close the loop of minds

Anna Strasser: Reciprocal exchanges of social cues in social interactions

SOCIAL RECIPROCITY IS LIKE WATER...

FOR LEARNING TO SWIM