5th Joint Action Meeting

July 26-29, 2013

Humboldt University
Senatssaal
Berlin, Germany

Organized by:
Anna Kuhlen, Günther Knoblich and Natalie Sebanz

Humboldt Universität zu Berlin, Germany

Program

	Friday, July 26
9:00	
10:30	
11:30	
12:00	Registration
1:00	Welcome
1:15	Talk session A *Philosophy Phirst I*
2:15	Micro-break
2:30	Talk session B *Philosophy Phirst II*
3:30	Coffee break
4:00	Talk session C *Philosophy Phirst III*
5:00	Micro-break
5:15	Discussion
6:00	End
6:15	Meet & Greet at Monbijou-Park

	Saturday, July 27	**Sunday, July 28**
8:30	Registration	
9:00	Talk session D *Perception and Attention*	Talk session H *Planning*
10:30	Poster session 1 / Coffee break	Poster session 2 / Coffee break
11:30	Talk session E *Coupling and Coordination I*	Talk session I Joint Thinking
1:00	Lunch	Lunch
2:00	Talk session F *Language Processing I*	Talk session J *Language Processing II*
3:30	Poster session 1 / Coffee break	Poster session 2 / Coffee break
4:30	Talk session G *Understanding Joint Action Through Disorders*	Talk session K *Development I*
6:00	End	End
8:00		Conference Dinner

	Monday, July 29
8:30	
9:30	Coffee
10:30	Talk session L *Development II*
11:30	Micro-break
11:45	Talk session M *Perspective Taking*
12:45	Lunch
1:45	Talk session N Coupling and Coordination II
3:15	Coffee break
3:45	Talk session O *Scaling up Joint Action*
4:45	Micro-break
5:00	Talk session P *Joint Intentionality*
6:00	End

Talk sessions

Talk session A: *Philosophy Phirst I*

Olle Blomberg
Common knowledge and genuine joint action

Emanuele Bottazzi and Nicolas Troquard
A logical and philosophical analysis of helping

Cedric Paternotte
Constraints on joint action

Talk session B: *Philosophy Phirst II*

Anika Fiebich, Sarah Schwarzkopf and Nhung Nguyen
What is cooperation? Perspectives from philosophy, psychology, and informatics

Marion Godman
Three roles for social motivation in joint action

Sara Parmigiani
Coordination games and joint actions. A look into the interactions between different levels of coordination.

Talk session C: Philosophy Phirst III

Frank Hindriks
Joint actions without intentions?

Angelica Kaufmann
Intention - ought to be - naturalized

Talk session D: Perception & Attention

Susan E. Brennan and Joy E. Hanna
Orienting cues and their potential for coordinating joint action

Allison A. Brennan and James T. Enns
Collaborative coactivation in visual search

Christina Becchio
Intention in action: from moving bodies to interacting minds

Liam Kavanagh
Reflections on mimicry from the Third Party Perspective

Talk session E: *Coupling and Coordination I*

Ivana Konvalinka, Markus Bauer, James Kilner, Andreas Roepstorff and Chris D. Frith
Believing versus interacting: Neural oscillations underlying interpersonal coordination

Mathilde Ménoret, Léo Varnet, Raphaël Fargier, Anne Cheylus, Aurore Curie, Vincent des Portes, Tatjana A. Nazir and Yves Paulignan
Neural correlates of non-verbal social interactions: Insights from single & dual-EEG analyses

Scott Jordan
Wild Interaction: Mirroring and coupled oscillation

Cordula Vesper
Mechanisms of intentional coordination: From minimal to information-rich contexts

Talk session F: *Language Processing I*

Carsten Allefeld , Anna K. Kuhlen and John-Dylan Haynes
Electrophysiological correlates of situation models coordinated between speakers and listeners

Sara Bögels, Dale Barr, Simon Garrod and Klaus Kessler
"Are we still talking about the same thing?" MEG reveals perspective-taking in interaction in response to pragmatic violations, but not in anticipation

Michael T. Tolston, Kevin Shockley, Michael J. Richardson, Michael A. Riley and Auriel L. Washburn
Speech and movement constraints on interpersonal coordination and communication

Judith Holler, Louise Schubotz, Spencer Kelly, Peter Hagoort and Asli Özyürek
Multi-modal language comprehension as a joint activity: the influence of eye gaze on the processing of speech and co-speech gesture in multi-party communication

Talk session G: *Understanding Joint Action Through Disorders*

Benoît G. Bardy, Manuel Varlet, Stéphane Raffard, Richard C. Schmidt, Delphine Cardevielle, Jean-Philippe Boulenger, Jonathan Delmonte and Ludovic Marin
Schizophrenia embodied

Mary Lavelle, Christine Howes, Partick G.T. Healey and Rosemarie McCabe
Nonverbal responsivity in schizophrenia: An analysis of patients' social interactions.

Paula Fitzpatrick, Veronica Romero, Joseph Amaral, Michael J. Richardson and R.C. Schmidt
The role of joint action in evaluating social competence in autism

Gérard Sensevy, Dominique Forest, Brigitte Gruson, Grace Morales and Henri Go
Semiosis process in the educational joint action

Talk session H: *Planning*

Roman Liepelt and Anna Stenzel
Specifying conditions for task co-representation

Geoff G. Cole, Mark A. Atkinson, Paul A. Skarratt and Andrew Simpson
Observers do not represent task intentions during joint action

Andrea Cavallo, Caroline Catmur, Sophie Sowden and Cristina Becchio
Inhibiting movements: when others slow us down

Luisa Sartori, Sonia Betti and Umberto Castiello
Motor cortex excitability: dissociating simulation and reciprocity

Talk session I: Joint Thinking

Janelle Szary and Rick Dale
Dyadic cooperation enhances retrieval and recall of crossword solutions

Jeremy Karnowski and Edwin Hutchins
Learning complementary action with differences in goal knowledge

David Kirsh and Linda T. Kaastra
What can we learn from the mechanisms underlying joint thought in music performance?

Kai Görgen, Rafael Schultze-Kraft, John-Dylan Haynes and Benjamin Blankertz
Cooperating brains: Dual-BCI as a new paradigm to investigate brain-to-brain coordination

Talk session J: *Language Processing II*

Fred Cummins
Speaking jointly: An unexplored gateway to highly significant and ubiquitous collective behavior

Gregory Mills
Dialogue in joint activity: coordinating on referring intentions and plans

Gareth Roberts
How small-scale interactions can exercise large-scale effects on language: An experimental test of two models of new-dialect formation

Georg Theiner
Between languaging and languagers: Rethinking knowledge of language

Talk session K: *Development I*

Marlene Meyer, Harold Bekkering and Sabine Hunnius
Learning how to play together: Neural and behavioural processes of joint action in early childhood

Sophie J. Milward, Sotaro Kita and Ian A. Apperly
The development of co-representation effects in a joint task: Do children represent a co-actor?

Joanna Rączaszek-Leonardi, Iris Nomikou and Katharina Rohlfing
The development of purposeful intersubjectivity

Kerry L. Marsh, A. Bhat, T. Davis, S. Srinivasan and M. Kaur
Joint action with robots

Talk session L: *Development II*

Elma Hilbrink, Merideth Gattis, Elena Sakkalou, Kate Ellis-Davies and Stephen Levinson
Development of turn-taking during infancy: Does the infant contribute?

Annette Henderson and Ying Wang
Visual habituation: A window into the ontogeny of infants' understanding of cooperative action

Emily Wyman
Investigating the behavior of children and chimpanzees in coordination problems

Talk session M: *Perspective Taking*

Tiziano Furlanetto, Valeria Manera, Andrea Cavallo, Barbara Tversky and Cristina Becchio
Through your eyes: contribution of gaze and action to spontaneous perspective taking

Alexia Galati and Marios N. Avraamides
Coordinating in spatial tasks: Representational and social constraints influence the perspective of speakers' descriptions

Giacomo Novembre and Peter E. Keller
Motor simulation and perspective taking mediate the co-representation and temporal integration of self and other in joint action. Evidence from a musical paradigm

Talk session N: Coupling and Coordination II

Juliane J. Honisch, Kimberly, A. Quinn and John T. Cacioppo
Behavioural asynchrony taints the interaction context?

Mary L. Malone, Michael A. Riley, Rachel W. Kallen and Michael J. Richardson
Dynamics of Simon says: The structure of response behavior during joint-action

Kristian Tylén, Johanne Bjørndahl, and Riccardo Fusaroli
A heart for cooperation: Reciprocal engagement and heart rate synchronization in a collective creative Lego construction task

Esther J. Walker, Walter F. Bischof and Alan Kingstone
Take my hand: The temporal and spatial coordination of handshaking

Talk session O: *Scaling up Joint Action*

Verónica C. Ramenzoni, Günther Knoblich and Natalie Sebanz
Scaling up perception-action links

Daniel Richardson, Beau Lotto, Rick Dale and John Rogers
Experiments in dynamic group action and decision making: How crowds of people can walk a tightrope together and survive a zombie attack

Mark T. Elliott, Briony S. Brownless and Alan M. Wing
Timing in the third person: The influence of visual and tactile cues on movement synchrony within a group of three

Talk session P: *Joint Intentionality*

John Michael
The sense of commitment

Elisabeth Pacherie
Commitments, predictability and joint action

Stephen A. Butterfill and Corrado Sinigaglia
Intention and motor representation in joint action

Poster sessions

Poster session 1

Franco Amati and Susan E. Brennan
What does Liz need? The role of gaze cues in intention recognition

Mark A. Atkinson, Geoff G. Cole, Andrew Simpson, Paul A. Skarratt
Action corepresentation and inhibition of return

Ed Baggs
A task for collaborative detection of structure in letter-strings

Anne Böckler, Leonhard Schilbach, Shirley-Ann Rueschemeyer, Bert Timmermanns, Kai Vogeley and Natalie Sebanz
Effects of observed eye contact on gaze following

Saša Bodiroza, Christian Grabolle and Verena V. Hafner
Reactive following handshake model for human-robot interaction

Aurélie Clodic, Severin Lemaignan, Amit Kumar Pandey, Lavindra de Silva, Mathieu Warnier and Rachid Alami
On robot decisional abilities for human-robot joint action

Charles A. Coey, Justin Hassebrock and Michael J. Richardson
Fractal structure in interpersonal coordination

Veronica Dudarev and R.R. Hassin
Switching all around: sharing of executive functions

Hinke M. Endedijk, A.H.N. Cillessen, R.F.A. Cox, Harold Bekkering and Sabine Hunnius
The role of child and peer environment Factors for peer cooperation in young children: A cross-sectional study

Alexandra L. Georgescu, B. Kuzmanovic, N.S. Santos, R. Tepest, G. Bente, M. Tittgemeyer and K. Vogeley
Neural correlates of perceiving dyadic social interactions

Sarah A. Gerson, Sabine Hunnius and Harold Bekkering
What are they doing?: Comparison between actions facilitates memory for viewed actions

Poster session 1 (contd.)

April D. Karlinsky, Keith R. Lohse and Nicola J. Hodges
Learning together: Peer-scheduled practice is as good as self-scheduling

Bibiane Klempova, Anna Stenzel and Roman Liepelt
Segregating my space from your space: Effects of physical separation on sequential modulations in a social Simon task

Daniel Lewkowic and Y. Delevoye-Turrell
Reading motor intention during competitive interactions

Tamara Lorenz, Björn Vlaskamp and Sandra Hirche
Movement synchronization under mismatched conditions

Marlene Meyer, Sabine Hunnius and Natalie Sebanz
Do 3-year-olds include a partner's task in their own actions? The emerging (Social) Simon effect

Mathias Moors
The effect of action on aggregate pattern perception in a music ensemble

Amit Kumar Pandey, Aurélie Clodic, Lavindra de Silva, Severin Lemaignan, Mathieu Warnier and Rachid Alami
Bottom up development of a robot's basic socio-cognitive abilities for joint action

David Peeters, Mingyuan Chu, Judith Holler, Ash Özyürek and Peter Hagoort
The Influence of communicative intent on the form of pointing gestures

Giovanni Pezzulo, Haris Dindo and Francesco Donnarumma
Sensorimotor communication: a theory of signalling in online social interactions

Daniel C. Richardson, Victoria Sinclair, Nicola Webb and Nick Duran
It ain't what you do, it's the way that you do it: contingency and similarity in behavioural coordination

Poster session 1 (contd.)

Amelie Rochet-Capellan, Leonardo Lancia and Susanne Fuchs
Breathing in human interactions

Veronica Romero and Michael J. Richardson
Is joint-action synergistic? A study of the stabilization of interpersonal hand coordination

Lucia Maria Sacheli, Andrea Christensen, Martin Giese, Nick Taubert, Enea Francesco Pavone, Salvatore Maria Aglioti and Matteo Candidi
Racial bias modulates joint-actions with ingroup vs outgroup avatars

Guido Schillaci, Verena Hafner, Bruno Lara and Marc Grosjean
Sensorimotor predictions and self-other recognition in robotics

Rafael Schultze-Kraft, Kai Görgen, John-Dylan Haynes and Benjamin Blankertz
Cooperating brains: Joint control of a dual-BCI

Claudia Scorolli, Massimiliano Miatton, Lewis A. Wheaton and Anna M. Borghi
Giving a mug to you,when your coffee and your eyes ask for it

Cordula Vesper and Janeen Loehr
Representing shared action outcomes: How novices learn to perform piano duets

David W. Vinson and J. Scott Jordan
Who carries your past? How social contexts and remembered actions influence perceived distance

Auriel Washburn and Michael J. Richardson
Aperiodic interpersonal coordination: The power of feedback delay

Kellie Williamson and Rochelle Cox
Collaborative cognition in sports teams

Poster session 2

Charlotte von Bernstorff, H.D. Brukhard, J. Nachtwei, N. Nestroj, M.C. Schneider and H. Wandke
Supervised joint action in complex microworlds

Arkadiusz Bialek, Molgorzata Stepien-Nycz and Marta Bialecka-Pikul
Infants' coordination of joint attention and joint action

Adam Boncz
Communicating action: Do we communicate information that helps performance in a task?

Bethany Burum
Believing an experience is shared changes memory

Francesca Capozzi, Tiziano Furlanetto, Andrea Cavallo, and Cristina Becchio
Altercentric intrusions from multiple perspectives: seeing it their way

Lincoln J. Colling, Natalie Sebanz and Günther Knoblich
Motor emulation for joint and parallel actions

John A. Dewey, Günther Knoblich and Natalie Sebanz
The sense of agency for jointly determined action effects

David Dignath
I remember your posture - observing other´s actions serve as a template for movement planning in social situations

Thomas Dolk, Roman Liepelt, Bernhard Hommel and Wolfgang Prinz
The cross-modal go-nogo Simon effect

Silviya P. Doneva and Goeff G. Cole
Inhibition of return in joint action: Time course and anxiety effects

Satoshi Endo, James Cooke, Ansgar Koene and Alan M. Wing
Spatial variability in a joint pointing task due to first-order motor correction

Poster session 2 (contd.)

Chiara Gambi, Joris Van de Cavey and Martin J. Pickering
Planning for others: Predicting how you will complete affects the timing of what I am saying

Sebastian Grüneisen
Children can solve coordination problems by using salience

Tatyana N. Kotova, Elizaveta Vlasova and Alexey A. Kotov
Only joint actions with related objects induce to taking the object labels as conventional

Dimitrios Kourtis, Meteusz Wozniak, Günther Knoblich and Natalie Sebanz
Predictive representation of others' actions in a synchronous joint task: An EEG study

Luisa Lugli, Cristina Iani, Nadia Milanese and Sandro Rubichi
The role of spatial correspondence parameters in the social transfer of learning effect

Marlene Meyer, Robrecht P.R.D. van der Wel and Sabine Hunnius
Planning ahead for me and you? Higher-order action planning for individual and joint object manipulations

Manfred Müller, Markus Müller, Armin Friedrich, Matthias Hornschuh, Gerd Schmitz and Alfred Effenberg
Generalized synchronization by acoustic stimulation in football

Akio Nishimura, Kazuhiro Akimoto and Kazuhiko Yokosawa
Seating arrangement in two-dimensional joint Simon task

Ana Pesquita, Timothy Corlis and James T. Enns
Perception of collaboration in joint musical performances

Paul Reddish, Ronald Fischer and Joseph Bulbulia
Synchrony, shared intentionality and cooperation

Veronica Romero, Mary Lauren Malone, Paula Fitzpatrick, Richard C. Schmidt and Michael J. Richardson
Capturing social motor coordination: Comparing the Microsoft Kinect, Video Analysis and Wireless Motion Sensor Tracking

Giovanni Rossi
When do people not add a verbal component to their requests?

Poster session 2 (contd.)

Richard C. Schmidt, James Boders and Mark Hallahan
Does motor synchrony really create interpersonal cooperation?

Laura Schmitz, Cordula Vesper, Natalie Sebanz and Günther Knoblich
Strategic reduction of variability for joint action coordination

Roberta Sellaro, Barbara Treccani and Roberto Cubelli
When task sharing eliminates interference: Evidence from the joint Picture-Word interference paradigm

Anna Stenzel, Alena Steinert and Roman Liepelt
Joint action changes attitudes towards the self and others

J. Lukas Thürmer, Frank Wieber and Peter M. Gollwitzer
Joint action and creativity: Collective implementation intentions improve idea generation performance

Pavel Voinov, Günther Knoblich and Natalie Sebanz
Within- and between-person integration of spatial visual information

Mircea Zloteanu and Daniel C. Richardson
Difference in single vs. pair judgements on deception detection, confidence and bias based on the level of communication

Abstracts

(in alphabetical order)

Electrophysiological correlates of situation models coordinated speakers and listeners

F

Carsten Allefeld[1,2,*], Anna K. Kuhlen[1,2,3,*]and John-Dylan Haynes[1,2,3]

[*] Both authors contributed equally to this work.

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[2] Berlin Center of Advanced Neuroimaging, Germany

[3] Humboldt-Universität zu Berlin, Germany

In communication people coordinate not only their behavior but also their mental states. To investigate whether these processes are reflected in neural coordination we measure the EEG of speakers and listeners during storytelling. By recording speakers on video while telling stories and later presenting these videos to listeners, we maximize experimental control while retaining a naturalistic setting. Based on a linear model of the speaker-listener coordination we compute the multivariate correlation between speakers and listeners at multiple time lags.

Experiment 1 disentangles the general effect of the video from the processing of communicated information. Videos of two speakers are superimposed and listeners are instructed to attend to one of the speakers. At a time lag of 12.5 seconds, the EEG of listeners is more strongly correlated with that of the attended than the unattended speaker. We interpret this delayed correlation to reflect a coordination of larger semantic units. With Experiment 2 we test this hypothesis more directly. By using stories that are either globally coherent or incoherent we manipulate the possibility for listeners to build up such situation models.

These studies investigate neural correlates of communication beyond the brain of an individual, and instead look at the relation between brain states of two individuals.

What does Liz need? The role of gaze cues in intention recognition

1

Franco Amati and Susan E. Brennan

Stony Brook University, USA

Eye gaze is a compelling social cue; interpreting the direction of another person's gaze can shape joint action (e.g., Hanna & Brennan, 2007). Following another's gaze direction has an automatic component, speeding RTs across a range of studies (Friesen & Kingston, 1998; Langton & Bruce, 1999) regardless of variables such as identity, facial expression, and personality (Frischen & Tipper, 2004). However, gaze-following does appear to be modulated by attributions about visual copresence and shared attention; these are crucial for detecting intentions relevant to joint action (Bockler, Knoblich, & Sebanz, 2011; Hanna & Brennan, 2007; Senju & Johnson, 2009). It is not enough to quickly allocate attention to another's gaze; one must infer the meaning behind the gaze. Few studies have directly addressed the link between intention recognition and gaze-following.In our experiments, we investigate the effects of a character's (Liz's) direction of gaze, while subjects attribute meaningful goals and intentions to her. We predicted faster RTs when gaze direction is congruent with the character's intended object, slower RTs when gaze is toward another object, and intermediate ones when object-directed gaze is absent. Preliminary results indicate support for these predictions. Results and implications will be discussed.

Action corepresentation and inhibition of return 1

Mark A. Atkinson[1], Geoff G. Cole[1], Andrew Simpson[1] and Paul A. Skarratt[2]

[1] University of Essex, UK

[2] University of Hull, UK

When two people sit opposite each other and take turns to reach for a target presented on the workspace located between them they are faster to make a reaching response that is egocentrically compatible with the previous response made by their partner (e.g., faster to reach to the right when their partner has just reached to their right). Various models are able to explain these findings in terms of shared action representations. However, an alternative attentional account suggests that rather than being facilitated, the compatible response is due to inhibitory processes following incompatible actions. Specifically, the large luminance transient induced by the observed arm movement induces inhibition of return at the location previously responded to. Three joint action experiments demonstrate that a person will inhibit a location that another person has just responded to even when the observed action is radically different to their own. We also show the compatibility effect can be abolished when aspects of the target stimuli are manipulated in line with classic attention experiments despite the two individuals performing identical actions. These findings support the hypothesis some joint action effects are driven by social cues conveying visuospatial information, rather than by shared action representations.

A task for collaborative detection of structure in letter-strings

1

Ed Baggs

University of Edinburgh, UK

Historically, many of the more open-ended tasks that have been considered within the cognitive science literature on dialogue have involved imposing communicative constraints on pairs of participants. Successful completion of these tasks depends in part on participants overcoming these constraints by devising new structures (new strategies, conventions, referring expressions, etc.) for coordinating with one another.

The present task attempts to present a different set of demands to partipicipants, within which the creation of such novel coordination strategies is possible, but not necessary for the completion of the task. Specifically, participants are shown strings of letters generated by a finite-state grammar, and are asked to classify novel strings as either well- or badly-formed relative to those they have already seen, and to discuss their reasoning with each other. The task is thus about detecting hidden structure from evidence placed in the environment.

It is hoped that tasks like this can provide a model environment for asking questions about what kinds of coordination strategies people are inclined to adopt in a naturalistic setting, what kinds of strategies are likely to be successful in a given context, and what kinds of cues can be placed in the environment to encourage such strategies.

Schizophrenia embodied

G

Benoît Bardy[1,2], Manuel Varlet[1], Stéphane Raffard[3,4] , Richard C. Schmidt[5], Delphine Capdevielle[4,6], Jean-Philippe Boulenger[4,6], Jonathan Delmonte[1,3] and Ludovic Marin[1]

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[2] Institut Universitaire de France, France

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[5] College of the Holy Cross, USA

[6] INSERM U-888, France

It has been demonstrated that motor coordination of interacting people plays a crucial role in the success of social exchanges. Abnormal movements have been reported during interpersonal interactions of patients suffering from schizophrenia and a motor coordination breakdown could explain this social interaction deficit, which is one of the main and earliest features of the illness. Using the dynamical systems framework, the goal of the current study was (i) to investigate whether social motor coordination is impaired in schizophrenia and (ii) to determine the underlying perceptual or cognitive processes that may be affected. We examined intentional and unintentional social motor coordination in participants oscillating hand-held pendulums from the wrist. The control group consisted of twenty healthy participant pairs while the experimental group consisted of twenty participant pairs that included one participant suffering from schizophrenia. The results showed that unintentional social motor coordination was preserved while intentional social motor coordination was impaired. In intentional coordination, the schizophrenia group displayed coordination patterns that had lower stability and in which the patient never led the coordination. A coupled oscillator model suggests that the schizophrenia group coordination pattern was due to a decrease in the amount of available information together with a delay in information transmission. Our study thus identified relational motor signatures of schizophrenia and opens new perspectives for detecting social deficits and improving social interactions of patients.

Intention in action: from moving bodies to interacting minds

D

Cristina Becchio

University of Torino, Italy

Starting from Descartes, philosophers, psychologists, and more recently neuroscientists, have often emphasized the idea that intentions are not things that can be seen. They are mental states and perception cannot be smart enough to reach the mental states that are hidden away (imperceptible) in the other person's mind. Based on this assumption, standard theories of social cognition have mainly focused the contribution of higher-level cognition to intention understanding. Only recently, it has been recognized that intentions are deeply rooted in the actions of interacting agents. In this talk, I present findings from a new line of research showing that intentions translate into differential kinematic patterns. Observers are especially attuned to kinematic information and can use early differences in visual kinematics to anticipate what another person will do next. This ability is crucial not only for interpreting the actions of individual agents, but also to predict how, in the context of a social interaction between two agents, the actions of one agent relate to the actions of a second agent.

Supervised joint action in complex microworlds

2

Charlotte von Bernstorff, H.D. Brukhard, J. Nachtwei, N. Nestroj, M.C. Schneider and H. Wandke

Humboldt Universität zu Berlin, Germany

Abstract

TBA

Infants' coordination of joint attention and joint action

2

Arkadiusz Białek, Małgorzata Stępień-Nycz and Marta Białecka-Pikul

Jagiellonian University, Poland

From the end of the first year of life infants, coordinate attention in a triadic interaction whereas they start to actively coordinate joint activity a few months later in the second year. The present study investigated the developmental relation between these two abilities. At 12 months, the infants were tested on initiation of joint attention (eye contact, gaze alternations, pointing to objects and showing them) and responding to joint attention (gaze and point following). At 18 months their ability to coordinate joint action was assessed with the use of the designed pretend game ('tea set'). After a period of pretending of drinking a tea, the tester would slow down and would cease their activity to wait for the child's reaction (e.g. he would pick the teapot up and he would stop the hand with the teapot in mid-way). Children's reactions to such a kind of experimenter's nonverbal prompts were indicators of the ability to coordinate joint action. The results revealed a positive, although weak correlation between responding to joint attention (following the line of regard) and children's responding to nonverbal suggestions in the joint action task. Initiating joint attention was not correlated with the ability to coordinate joint action. These findings suggest the existence of the developmental relation between participation in joint attention at 12 months and coordination of joint action at 18 months.

Common knowledge and genuine joint action

A

Olle Blomberg

University of Edinburgh, UK

According to most philosophical accounts of joint activity, in order for two or more agents to be acting together, they must have “common knowledge”—or “mutual knowledge”—of each other’s goals or intentions concerning the activity (e.g. S. Miller 2001; Alonso 2009; Bratman 1992, 1993; Pettit & Schweikard 2006; Cohen & Levesque 1991; Tuomela & K. Miller 1988). But while this requirement is common, it is almost never explained or motivated. In this talk, I suggest that there are two reasons for thinking that common knowledge might be a constitutive element of genuine joint action: (i) it is needed to rule out certain class of cases--"concealment cases"--that would only counterintuitively be categorised as cases of genuine joint action, and (ii) to make sense of the idea that a properly joint action should be non-accidentally coordinated in the right way. I argue that both (i) and (ii) can be achieved without common knowledge, and hence, common knowledge cannot be a constitutive element of genuine joint action. One reason why this conclusion may be important is that it allows us to make sense of the possibility of genuine joint action involving agents who lack the concept of belief (such as, perhaps, young children).

Effects of observed eye contact on gaze following

1

Anne Böckler[1,2], Leonhard Schilbach[3,4], Shirley-Ann Rueschemeyer[5], Bert Timmermans[3], Kai Vogeley[3,6] and Natalie Sebanz[1,7]

[1] Donders Institute for Brain, Cognition, & Behaviour, The Netherlands

[2] Max-Planck-Institute for Human Cognitive and Brain Sciences, Germany

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[4] Max-Planck-Institute for Neurological Research, Germany

[5] University of York, UK

[6] Research Center Juelich, Germany

[7] Central European University, Hungary

Recent studies show that gaze following is enhanced when eye contact has been established between the gazer and the follower. The present studies investigated whether observing eye contact between others also enhances subsequent gaze following. Participants saw two faces looking at each other or away from each other before jointly shifting gaze to one of two locations. Targets appeared either at the cued or at the non-cued location. Results revealed enhanced gaze cueing effects (faster responses to targets appearing at the cued location) when the two faces had looked at each other before shifting gaze. Hence, observed eye contact in others is interpreted as an ostensive cue, signifying that an upcoming gaze will be meaningful. When the same experiment was performed by participants diagnosed with Asperger autism, gaze following was not enhanced by observed eye contact. This suggests that autistic participants' were not susceptible to the ostensive cue of observed eye contact. In a final study, fMRI data was acquired while participants performed the experiment. Imaging results indicate that regions linked to social cognition and social attention (left inferior temporal, left inferior parietal, and right precentral regions) underlie the effect of observed eye contact on gaze following.

Reactive following handshake model for human-robot interaction

1

Saša Bodiroža, Christian Grabolle and Verena V. Hafner
Humboldt-Universität zu Berlin, Germany

The handshake represents a complex and synchronized joint action between two agents. In the following work, three handshake models are implementedand tested on a humanoid robot -- sinusoid model, copying or tit-for-tat model, and reactive following model. The hypothesis is that the reactive following model will perform better than the former two models due to the robot adapting to the person's hand movement. The former two models are based on the previous work of others ([1], [2]), while the third model is a novel introduction in this work. The study is conducted with human participants. During the study, a participant shakes the robot's right hand. Participants were instructed to repeat the handshake 4-5 times. This is followed by an adapted version of the Godspeed questionnaire [3], which is used to asses the particular handshake model (e.g., how human-like the movement is). The order of the presented handshake models is randomized for each participant. Preliminary results show that the handshake preferences differ, but are promising. Full results will be presented at the JAM.

[1] I. Nisky, G. Avraham, and A. Karniel, "Three alternatives to measure the human-likeness of a handshake model in a turing-like test," Presence: Teleoper. Virtual Environ, vol. 21, no. 2, pp. 156-182, 2012.

[2] G. Avraham, I. Nisky, H. L. Fernandes, D. E. Acuna, K. P. Kording, G. E. Loeb, A. Karniel, "Toward Perceiving Robots as Humans: Three Handshake Models Face the Turing-Like Handshake Test," IEEE Transactions on Haptics, vol. 5, no. 3, pp. 196-207, 2012.

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"Are we still talking about the same thing?" MEG reveals perspective-taking in interaction in response to pragmatic violations, but not in anticipation

F

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The current study investigates whether "mentalizing", or taking the perspective of your interlocutor, plays an essential and constant role while two people are interacting, or whether it is mostly used in reaction to misunderstandings. This study is the first to use a brain-imaging method, MEG, to answer this question. In a first phase of the experiment, MEG participants interacted with a confederate who set naming precedents for certain pictures. In a second phase, these precedents were sometimes broken; a speaker named the same picture in a different way. This could be done by the same speaker, who set the precedent, or by a different speaker. Source analysis of MEG data in the second phase showed that in the 800 milliseconds before the naming, when the picture was already on the screen, episodic memory (e.g., parahippocampal gyrus) and language areas (e.g., temporal areas) were activated, but no mentalizing areas, suggesting that the speaker's naming intentions were not anticipated by the listener on the basis of shared experiences. Mentalizing areas (i.e., temporoparietal junction, ventromedial prefrontal cortex, precuneus) only became activated after speakers broke their own precedent, which we interpret as a reaction to the violation of conversational pragmatics.

Communicating action: Do we communicate information that helps performance in a task?

2

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Communication, as a means for coordination, has been studied extensively and it has become clear that people communicate with regard for the mental state of the collocutor. Here, we studied whether people communicate also with regard for the performance, by providing information about the most relevant aspect of a task performed by the collocutor. To answer this question, we used a two-person precuing paradigm where one participant is asked to perform a choice reaction time task and the other participant provides precues for her. By controlling the set of possible precues (signals) and the task parameters, we could examine the direct relation between communication and task performance. Our initial experiments discovered the basic mapping rules that participants applied between signals and task aspects. Using this technique, further experiments can reveal, under which circumstances we can coordinate actions effectively by communication..

A Logical and Philosophical Analysis of Helping

A

Emanuele Bottazzi and Nicolas Troquard

LOA ISTC-CNR, France

Helping is not much considered in the literature of analytic social philosophy. According to Tuomela (2000), when A helps an agent B, A contributes to the achievement of B's goal, and B accepts A's contribution to the goal. We take a rather different tack: helping is one sided, triggered by an attempt, and subjective. It is one sided because we can provide our help to someone without her accepting it. She could be unaware of our helping, or unwilling to receive it. Helping is based on trying because it is agent B (supposedly) trying to do something that triggers A's action of helping (Warneken and Tomasello 2009). Finally, helping is subjective since in helping B, agent A can wrongly interpret B's goals. This analysis will be driven by a formal, logical approach, based on the modal logics of agency. This will assist us in taking sensible philosophical choices, avoiding blatant inconsistencies and will have also the potential to serve as a computational engine for implementing concrete societies of cooperating autonomous agents.

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Collaborative coactivation in visual search

D

Allison A. Brennan and James T. Enns

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Individuals experience a redundancy gain when they can respond faster to two signals than one. This benefit can derive from statistical facilitation of independent decisions (Raab 1962) or from the co-activation of signals prior to a decision (Miller, 1982). Here we applied these tests to the redundancy gain that occurs when participants work in pairs rather than individually on a task. When working in pairs, we also compared gains when each partner was responsible for one of two targets versus when each was responsible for a different spatial region. The results showed pairs were more efficient than individuals, and that this benefit was greater when the task was divided by target identity versus by space. We also found that the collaborative redundancy gain could be characterized as co-activation, meaning that the benefit of collaboration exceeded that predicted by statistical facilitation. Considering that search in an individual is limited to one item at a time (Houtkamp & Roelfsema, 2009) whereas space can be examined in parallel, this suggests that the collaborative benefit results from dividing the attentional load. Together, these results serve as a proof of concept that models developed to understand information processing in individuals can help characterize collaborative performances.

Orienting cues and their potential for coordinating joint action: The eyes have it, but what about the head?

D

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Gaze is a powerful cue in interaction. Face-to-face, addressees use speakers' direction of gaze to resolve ambiguity in referring expressions, even before hearing disambiguating linguistic information (Hanna & Brennan, 2007; 2013). Abstract representations work also; remotely-located partners use each other's moving gaze cursors to coordinate visual search strategies (Brennan et al., 2008; Neider et al., 2010). Is head orientation potentially useful as well? Anecdotal evidence suggests people believe it is: Cheating students try to escape detection by keeping heads oriented straight ahead while moving just their eyes. And in non-interactive studies, head orientation can be an independent cue to attention (e.g., Langton & Bruce, 2000). Head and eye cues may well differ in utility or costs: Fixating an object is instrumental to referring to it (Griffin, 2001), and looks are easier to initiate than head turns (Freedman, 2008; Zangemeister & Stark, 1981). On the other hand, head orientation, which reliably co-occurs with gaze, is salient enough to track in peripheral vision, so may be the more effective cue. In a face-to-face referential communication experiment with speakers wearing sunglasses or not, we found that head orientation was not useful in early disambiguation. Implications for different cue types will be discussed.

Believing an experience is shared changes memory

2

Bethany Burum

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Can merely believing that another person is doing the same thing at the same time change our memory? Three studies tested the effect of *co-experience*—the belief that another person is having the same experience at the same time. Participants viewed and imagined drawings of common objects while believing a confederate was either completing the same task (the *co-experience condition*) or a different task (the *solo experience condition*). Participants returned 2-7 days later and took a surprise memory test for the objects. During the test, a picture of the confederate either did appear on the screen (the *reminded condition*) or did not appear (the *unreminded condition*). Results showed that perceived mental synchrony influenced the effect of the confederate's picture on participants' memory. Although the picture of the confederate improved memory for participants in the solo experience condition, it impaired memory for participants in the co-experience condition. Based on previous research, these results, replicated in several follow-up studies, suggest that solo experience participants encoded the confederate as a part of the study context, like another chair in the room, whereas co-experience participants encoded the confederate as a part of the study experience, along with the items they saw or imagined.

Intention and Motor Representation in Joint Action

P

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To characterise shared agency, some researchers appeal to a special kind of intention or structure of intention, knowledge or commitment often called `shared intention'. In this talk we show that there are forms of shared agency characterising which requires appeal to structures of motor representation. Joint action is not only a matter of what we intend: sometimes it constitutively involves interlocking structures of motor representation.

Shared motor representation and shared intention have distinctive roles in explaining the purposiveness of joint action, as we shall explain. This gives rise to a challenge. On the one hand, effective joint action---imagine two people erecting a tent in a gale together---sometimes requires both shared intentions and shared motor representations plus a certain kind of harmony between the two. On the other hand, recognizing their distinctive roles precludes the existence of direct inferential links between shared intentions and shared motor representations. The challenge is to explain how these two kinds of representation could sometimes harmoniously contribute to effective joint action despite the lack of inferential integration.

Altercentric intrusions from multiple perspectives: seeing it their way

2

Francesca Capozzi, Tiziano Furlanetto, Andrea Cavallo, and Cristina Becchio

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Recent findings suggest that human observers rapidly and involuntary process the perspective of another person and cannot easily resist to altercentric intrusions of her viewpoint (Samson et al. 2010; Surtees & Apperly 2012). To date, altercentric intrusions in self-perspective judgments have been reported in presence of one person holding a discrepant perspective. However, real-world perspective-taking problems frequently involve interactions with more than one individual. Are multiple perspectives spontaneously computed? Does the presence of more people cause altercentric intrusions from different viewpoints? To answer these questions, we adapted the paradigm employed by Samson et al. (2010) to include two avatars in the scene. Participants were asked to judge their own or the avatars' visual perspective in situations where perspectives were either the same or different. Depending on condition, the avatars held the same focus of attention (i.e., both attending to the same objects; convergent condition) or different foci of attention (i.e., attending to different objects; divergent condition). Results are discussed with reference to the hypothesis that i) processing of multiple perspective inhibits altercentric intrusions; ii) efficiency of the computation of multiple perspective is modulated by the attentional relation (convergent vs. divergent) between observed people.

Inhibiting movements: when others slow us down

H

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Recent observations suggest that people may represent responses that another person carries out. This co-representation allows prediction of others' responses and leads to response conflict in joint interference tasks.

The aim of the present study was to explore, by means of a stop signal paradigm, the influence of co-representation on response inhibition. Are joint actions more difficult to inhibit compared to solo actions? A first behavioural experiment showed that participants needed more time to stop a planned joint action compared to a planned solo action. A second TMS study demonstrated that joint stopping recruited a more selective suppression mechanism than solo stopping.

Taken together these results suggest that participants may use a global inhibition mechanism when acting alone; however, they may recruit a more selective and slower suppression mechanism when acting with someone else. These findings are discussed with reference to different notions (strong-intermediate-weak) of co-representation.

On robot decisional abilities for human-robot joint action

1

Aurélie Clodic, Severin Lemaignan, Amit Kumar Pandey, Lavindra de Silva, Mathieu Warnier and Rachid Alami

Université de Toulouse, France

While interacting with humans, a robot needs tools to orchestrate and manage joint actions/goals to achieve collaborative activities in a human understandable manner. We present a robot control system especially designed for a cognitive robot that shares space and task with a human partner. It is composed of three main activities:

1. Knowledge and context management: the robot has a central symbolic knowledge base that is able to represent not only robot's own knowledge/belief but also those of the human it interacts with. It is equipped with reasoning capabilities that help not only to extend its database but also to represent/ ground/reason about differences/similarities between each participant's knowledge/beliefs/abilities.

2. Goal and plan management: a dedicated human-aware task planner enables the robot to plan for its own actions as well as those of its human partner, taking into account how these actions could be interleaved to achieve a joint task. The planning domain can be tuned by altering action costs and utilities with respect to social rules and the commitment of actors to the task.

3. Action refinement, execution and monitoring: a supervision system has been designed, which facilitates interleaving communication and acting during joint action execution. It is based on communication schemes composed of communicative acts shared between the robot and the human. Each act is described as a set of actions and/or monitoring abilities/needs.

Based on these ingredients, we propose a collaborative human-robot task achievement process that we view as a pertinent instance of human-robot joint action.

Fractal Structure in Interpersonal Coordination

1

Charles A. Coey, Justin Hassebrock, and Michael J. Richardson

University of Cincinnati, USA

Many recent research efforts have uncovered complex patterns of variation in repeated measurements of human behaviors, loosely referred to as “fractal structure”. More interestingly, several studies have demonstrated that experimental manipulations can bring about shifts in fractal structure. In a classical example, when participants rhythmically tap a key at a self-paced tempo, the intervals between the taps exhibit fractal structure. Having participants coordinate their taps with a metronome stimulus, however, reveals a markedly different pattern of variation. Recent theoretical work suggests that the nature of such fractal structure is indicative of the dynamical organization of the participant-task system under investigation. In a number of experiments, we have attempted to extend this account to joint action systems. Specifically, our participants are required to coordinate their taps either with stimuli generated by another participant or during online interaction with another participant. Moreover, we employ other experimental manipulations (e.g., metronome stimuli) to constraint one, or both, of the actors’ tapping behavior. Collectively, these experiments suggest that the coordination of joint actions, like solo actions, is best understood in terms of “interaction-dominant dynamics”; that the organization of behavior is not driven by one dominant process, but instead is the end-product of many interdependent processes.

Observers do not represent task intentions during joint action

H

Geoff G. Cole[1], Mark A. Atkinson[1], Paul A. Skarratt[2] and Andrew Simpson[1]

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A number of studies have shown that the observation of another's action influences the performance of a subsequent action by the observer. For instance, when participants sit opposite each other and make alternate reaching responses to locations on a shared work surface, responses that are egocentrically compatible with a partner's last response are facilitated (e.g., faster to reach to the left following an observed left reach). An important question is whether observers' movement kinematics represent the intentions and goals of an observed reach. Although Ondobaka et al. (2012) found this to be the case, Cole et al. (2012) did not. In the current work participants undertook variants of the basic paradigm in which they made alternating reaching responses to a target located on the shared workspace. Importantly, either their reaching action had the same intention as their partner or a different intention. In a number of experiments, results showed that although an overall effect of task congruency was observed, the compatible action effect was not modulated according to whether participants had the same intention or not. These results support Cole et al. (2012); mechanisms responsible for movement kinematics do not represent end-point goals and intentions.

Motor emulation for joint and parallel actions

2

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Many forms of joint action require agents to coordinate their actions not with another single agent but with a group of agents. Recent theory suggests that the ability of agents to emulate the actions of their co-actors with their motor system plays a crucial role in supporting coordination; however, most previous work has focused on the single agent case with the multiple agent case largely neglected. In this study, we introduce a novel paradigm studying the multiple agent case. Participants were required to observe, and make judgements about, a single action while observing two simultaneous which could either be part of a joint action or two actions performed in parallel. We measured the influence of the non-judged action on the perception of the judged-action. The logic this paradigm follows that of previous studies that have investigated the influence of performed actions on action perception, and vice versa results are discussed in terms of parallel emulation of multiple actions, and possible mechanisms for integrating multiple parallel emulations are discussed. Finally, differences in how parallel and joint actions are also discussed.

Speaking Jointly: An unexplored gateway to highly significant and ubiquitous collective behavior

J

Fred Cummins

University College Dublin, UK

The scientific study of speech has treated of speech almost exclusively as an act performed by one individual at a time. Yet joint speech, where multiple people say the same thing at the same time, is frequent, and occurs mainly in situations that are highly charged with significance. Joint speech includes collective prayer, mass displays of allegiance to secular powers, and expression of joint purpose in acts of protest and demonstration. The study of joint speaking thus holds promise to further our understanding of group intentionality. Joint speaking practices are deeply embedded in the rituals and practices of virtually every culture. Close analysis of the form of joint speech reveals some interesting properties. Unlike most other forms of synchronized action that are scaffolded by either a periodic reference, and/or a strong physical link to a shared environment, synchronization in joint speech exhibits neither property, and yet tight synchronization of this highly complex action is achieved effortlessly, and does not improve much with practice. Laboratory study of synchronized speech has revealed that speakers become coupled, that the coupled system is vulnerable to perturbation, and that the stability of the coupling may depend, in part, on the phonological structures of the language.

The sense of agency for jointly determined action effects

2

John A. Dewey, Günther Knoblich, and Natalie Sebanz

Central European University, Hungary

The sense of agency (SA) is the perception of willfully executing and controlling an action. When acting individually, an agent's SA depends on congruence between the predicted, intended, and actually perceived effects of the action. However, little is known about SA for action effects which are jointly determined by the combined efforts of multiple agents. One hypothesis is that SA highly individualistic, depending only on the match between self-predictions and perceived action effects. Alternatively, individuals may develop a sense of joint agency which accounts for other agents' intentions and predicted behaviors, and ultimately reflects satisfaction of joint action goals. We will consider two contexts: a cooperative joint action in which individual and joint action goals are indistinguishable (Exp 1), and another where achievement of a joint action goal depends on acting sub-optimally from an individualistic standpoint (Exp 2). The individualistic hypothesis predicts that attaining the joint action goal should increase SA in Experiment 1, but not in Experiment 2, whereas the joint agency hypothesis predicts that achievement of the joint action goal in Exp 2 should increase SA, despite short-term discrepancies between each individual's action and the jointly determined outcome.

I remember your posture – observing other´s actions serve as a template for movement planning in social situations

2

David Dignath

University of Würzburg, Germany

Previous studies of anticipatory movement planning showed that initial comfort of a posture is traded for an optimal control at the end position. An end-state comfort effect is however not observed when participants recall a recently performed motor plan.

We investigated whether observing the grasp of another person is sufficient for later recall. Participants moved an object from a home location to different target positions. Results revealed an inverse relation of grasp height to target height, replicating the end-state comfort effect. When participants later returned the object back to the home position, recall of the previously self-performed action dominated and the end-state comfort effect was abolished. Most important, the end-state comfort effect was also abolished when a model performed the first movement and when a participant moved the object back to the home position. This was further supported by a clear correlation between the grasp height of the model and the participant: The higher the model grasped the plunger during the movement to the lower target field, the higher the participant grasped when returning the plunger back to the home field.

These results suggest that observed actions of others can serve as a template for own movement planning in social situations. Indeed memorizing actions of other persons is a key prerequisite for observational learning and social interaction.

my favorite cousin will get married on Saturday, the 27th and since I would love to be at the JAM - I´d like to ask if (in case my submission will be accepted) it would be possible to put my poster in the later poster slot (assuming that there will be 2 poster presentations).

The Cross-Modal go-nogo Simon effect: Salient stimulus events induce referential response coding in the go-nogo Simon task

2

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Sharing a *go-nogo Simon task* with another person typically elicits a *Stimulus-Response-Compatibility Effect* across both participants (*joint cSE*). In contrast to the *social co-representation account*, recent findings suggest that the (joint) cSE may result from any salient event that provides a reference for spatially coding one's own action. Here, we tested this *referential coding account* by having participants perform an *auditory* or *visual* go-nogo Simon task. They responded to their assigned modality only (either color or tone) in the presence (*joint-condition*) or the absence of a human co-actor (*single-condition*). Results showed reliable cSEs in both conditions, indicating that salient stimulus events are effective to modulate the representation of alternative events in a go-nogo Simon task. That is, introducing other salient (i.e., attention attracting stimulus/response) events induces a discrimination problem: Now the actor needs to differentiate between the representation of their own required action and the representation of all concurrently activated events, which can be achieved by *referential coding* - the spatial coding of one's action relative to the other expected or real (response) event(s). This intentional weighting of action alternatives, in turn, lead to matches or mismatches of stimulus and response sets – a necessary condition for Simon effects to emerge.

Inhibition of return in joint action: Time course and anxiety effects

2

Silviya P. Doneva and Geoff G. Cole

University of Essex, UK

Social inhibition of return (IOR) is a newly-discovered phenomenon referring to slower reaching responses to targets appearing at locations where another individual has just responded. The goal of the present research was to investigate the influence of two factors on the effect. In both studies, the basic social IOR paradigm was used in which two participants, sitting opposite one another alternated responses to the appearance of a target presented on a table touchscreen. Experiment 1 examined how long the phenomenon lasts by manipulating the duration of the inter-stimulus interval between targets. Results showed that social IOR occurred only when the interval was short (1200 ms). Experiment 2 investigated whether anxiety modulates the phenomenon by assessing the strength of the effect in participants who were either low or high on trait anxiety. Results indicated that although social IOR was no different in high and low-trait anxious individuals, overall response times did differ in the two groups. The present research has theoretical implications for the better understanding of the phenomenon and what factors may or may not play role in it.

Switching all around: sharing of executive functions

1

Veronica Dudarev and R. R. Hassin

Hebrew University of Jerusalem, Israel

In previous studies it was shown that when doing something together with somebody, people act as if they were doing the whole task alone (1). This effect was demonstrated for a number of tasks (2-4). The present study aimed to extend these findings to higher-order executive functions, namely to set-switching.

We used a set-switching task (5) modified in the following way. Each participant was instructed to respond to only one of the two tasks, and to simply view the trials of the other one. Following the modal paradigm in the joint action literature, we compared performance on this task in three conditions: individual; joint performance, in which one partner is responsible for one task and the other one for the other task; and joint performance of one task (the same task for both participants).

Switching costs were evident in the two joint, but not in the individual condition. Importantly, switching costs in the joint set-switching condition were higher than in the joint no-switching condition. These results demonstrate that the executive functions that are tapped by set-switching tasks are also shared in a joint action environment, and that they can be incidentally triggered in such environments.

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Timing in the third person: The influence of visual and tactile cues on movement synchrony within a group of three

O

Mark T. Elliott, Briony S. Brownless and Alan M. Wing

University of Birmingham, UK

A group moving in synchrony is an important requirement across many tasks, including music, dance[1] and sport[2]. Furthermore, group synchrony can occur spontaneously, such as during an audience applause[3] or when walking as a group[4]. For group synchrony to occur, each individual must match the tempo and phase of their own movements to each of the other group members. However, given individual variability in tempo and phase, the question arises how does each group member combine the cues from other members in order to synchronise their own actions? I will discuss results from two experiments that examine how movement information from two group members is combined by a third member to form the cues with which they synchronise. Using metronomes presented over headphones, we manipulated phase and variability between the two group members being observed and further manipulated the availability of visual and tactile cues within the group. Our results suggest that the third member minimises their own timing variability rather than the variability across the group when substantial discrepancies exist between the other two members. We further show that tactile contact between group members in addition to vision increases the strength of the synchrony within the group.

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The role of child and peer environment factors for peer cooperation in young children: A cross-sectional study

1

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Although there are large individual differences between children in their cooperation development (Eckerman & Peterman, 2004), it has not been examined to date which factors influence the development of successful cooperation.

We tested 133 same-sex dyads of 2-, 3-, and 4-year-olds in a task based on the double-tube task of Warneken and Tomasello (2006). This task consisted of two tubes of one meter (Figure 1). The two children were handed a figure in a swimsuit and a swimming pool and were instructed that the figure wanted to go to the swimming pool. Task performance was measured in terms of task success as well as interaction quality. Parents completed a questionnaire about the child's social competence, temperament and about the number of siblings and daycare attendance.

The results show that the cooperation skills of children developed age. Temperament was related to affiliative and cooperation success (Figure 2). For 2-, and 3-year-olds affiliative behavior was positively related to cooperation . Childcare attendance was positively related to cooperation success.

The present findings add to our on the development of cooperation in young children and provide insight in predictors for differences in peer cooperation.

Spatial variability in a joint pointing task due to first-order motor correction

2

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The present study investigated a strategy people use to jointly coordinate their movements in space. In this study, paired participants repetitively pointed in space and maintained the point as close to each other as possible. The visual feedback was controlled so both or only one of the pair had visual feedback of the pointed locations. To vary the reaching directions between the pair (and underlying biomechanics), the seating angle of the pair was varied. The pointed locations were recorded and correlational structures of within- and between-pair pointing variability were analysed.

A cross-correlation analysis showed that there was a positive lag1 correlation in pointing locations between the paired participants suggesting that they adjusted to the partner's pointing location in subsequent responses. The correlation was particularly strong when the other person had no visual feedback, and it increased with a shift of the seating angle. In contrast, a larger negative lag1 autocorrelation was observed in conditions at which between-pair lag1 correlation was lower, indicating motor adjustments were made towards the centre of the response distribution. The study suggests that the joint spatial action is largely explained by a first-order regressive model but not when the required action of the pair is ostensibly symmetric.

What is cooperation? Perspectives from philosophy, psychology, and informatics

B

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- *equal contribution*

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Cooperation is a popular topic in philosophy, psychology, and informatics. Being discussed in the framework of various experimental paradigms and from the perspective of different philosophical traditions, 'cooperation' easily became an inflationary used notion. In this talk, we aim to provide a conceptual taxonomy that is capable of capturing the various aspects of 'cooperation' that are discussed in the current literature. We start with providing an account of what the minimal conditions of 'cooperation' are and continue with discussing various further dimensions that may come into play in complex forms of cooperation. This taxonomy shall serve as a fruitful means for scientists not only to locate themselves in the debate but also to facilitate the dialogue on cooperation among scientists from different disciplines and traditions. For the sake of simplicity, we focus on cooperative activities (i) among pairs of agents and (ii) that are performed by human adults compared to robots.

The role of joint action in evaluating social competence in autism

G

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[1] Assumption College, USA

[2] University of Cincinnati, USA,

[3] College of the Holy Cross, USA

Children with ASD have difficulty interacting with others, but the specific processes underlying such social competence impairments are not well understood. An important key for increasing our understanding of ASD-specific social deficits may lie not with the cognitive coordination of thoughts and ideas but with social movement coordination that takes place when we implicitly coordinate our bodies with others. Here we evaluate the relationship between social motor coordination and social cognitive coordination and explore whether social competence is uni- or multi-dimensional by investigating whether dynamical measures of social motor coordination can index social skills that differentiate those with ASD. We evaluated cognitive measures of social competence of children with and without ASD as well as time series records of social motor coordination. A preliminary factor analysis resulted in three factors that explained 73% of the variance—a social attention factor that explained 32%, a social knowledge factor that explained 24%, and a social action factor that explained an additional 17% of the variance. These findings suggest that social coordination may not be a unitary construct, raising the possibility that there are separate and distinct dimensions of social competence (one of which is related to joint action) with non-shared underlying mechanisms.

Through Your Eyes: contribution of gaze and action to spontaneous perspective taking

M

Tiziano Furlanetto, Valeria Manera, Andrea Cavallo, Barbara Tversky, and Cristina Becchio

University and Polytechnic of Torino, Italy

What makes people spontaneously adopt the perspective of another in the absence of communication? Previous work implies that perspective taking can serve understanding the actions of others. Three experiments corroborate and extend that interpretation.

The first experiment varied cues to intentionality of action, eye gaze and interactivity, and found that the more the actor was perceived as potentially interacting with the objects, the stronger the tendency to take his perspective. In the second experiment, the actor's face was blurred and in the third experiment, the actor reached towards a glass without looking at it. Eliminating gaze cues by blurring the face did not reduce perspective-taking, suggesting that in the absence of gaze information, observers rely entirely on the action. Intriguingly, perspective-taking was higher for the anomalous situation, when gaze was not directed at the object, suggesting that perspective taking increases when understanding action is difficult.

A heart for cooperation: Reciprocal engagement and heart rate synchronization in a collective creative Lego construction task

N

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What does it mean to cooperate? How do we share meanings and actions in order to reach a common goal? In this paper we explore the relation between cooperative coordination and heart rate. We argue that in cooperative contexts participants synchronize their heart rhythms according to two factors: the affordances of the task at hand and the gradual consolidation of collaborative practices. Six groups of participants were instructed to construct LEGO models of six abstract notions ("responsibility", "knowledge", "justice" etc.), both individually and in groups. We combine video analysis and heart rate measurements and employ recurrence analysis techniques to quantify the mutual adaptability of heart rates among the participants in the different tasks. We show that during individual tasks individual heart rates synchronize both within and between groups (but not with controls) plausibly due to the affordances of the task at hand. We also show that during collective, but not individual tasks, within group synchronization grows over time. Finally, we discuss how these measures of synchronization relate to the participants' engagement in the tasks at hand and to the end products (LEGO models) of their joint activity.

Coordinating in spatial tasks: Representational and social constraints influence the perspective of speakers' descriptions

M

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Across two experiments, we examined how speakers' descriptions of spatial information are shaped by social constraints (the conversational partner's viewpoint) and representational ones (e.g., the speaker's viewpoint, their misalignment from their partner, and the layout's intrinsic orientation). In Experiment 1, Directors studied randomly configured layouts while either knowing or not knowing their Matcher's subsequent viewpoint, which was misaligned by 90°, 135°, or 180°. Directors used partner-centered spatial expressions more frequently when misaligned by 90o and egocentric ones when misaligned by 135o. Advance knowledge of their misalignment helped partners recognize when descriptions would be difficult for Directors, as evidenced by more explicit agreements to use their perspective at 135o. In Experiment 2, the layout's symmetrical structure was aligned with the Director, the Matcher, or neither partner in descriptions, with partners knowing this in advance or not. Directors used more egocentric expressions when the intrinsic structure was aligned with them, and more partner-centered expressions when the intrinsic structure was aligned with their Matcher. In both experiments, memory tests preceding descriptions elucidated the representations supporting Directors' adaptation. Altogether, speakers use converging social and representational cues, whether available perceptually or a priori, and adapt their descriptions flexibly in ways that minimize collective effort.

Planning for others: Predicting how you will complete affects the timing of what I am saying

2

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If interlocutors predict aspects of each other's utterances via production processes (Pickering & Garrod, in press), anticipating another's words should have similar effects on production as anticipating one's own words when planning ahead.

Forty-eight pairs of speakers described pictured events. Sentence preambles (e.g., *The policeman chases...*) were held constant, whereas the length of the object varied (short: *...the monk* vs. long: *...the monk with the basket and the sailor*). Participants produced the full sentence (SOLO), stopped after the verb (NO) or stopped after the verb while their partner continued (JOINT). This manipulation was randomized in Experiment 1, blocked in Experiment 2; we report combined linear mixed-effects analyses.

Participants who overlapped with their partner on more than 10% of trials and all remaining overlapping trials were discarded. In the SOLO condition, longer preambles before longer (1006ms) than shorter (961ms) completions indicated that speakers were planning ahead. This was not the case in the NO condition (long: 1108ms, short: 1101ms; Condition-by-Length interaction: B=38ms, SE=17ms, t=2.28).

Importantly, the effect of length was (marginally) larger in the JOINT (long: 1091ms, short: 1054ms) than in the NO condition (Condition-by-Length interaction: B=29ms, SE=17ms, t=1.72). This suggests that speakers predicted the length of their partner's completion and were affected by this prediction while producing the preamble.

Pickering, M., & Garrod, S. (in press). An integrated theory of language production and comprehension. *Behavioral and Brain Sciences*.

Neural correlates of perceiving dyadic social interactions

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The aim of the present study was to determine the differential contributions of the action observation network (AON) and the social neural network (SNN) to the processing of nonverbal behavior as observed in dyadic social interactions. To this end, we used short animation sequences displaying dyadic social interactions between two virtual characters and systematically manipulated kinematic features of their social dynamic. A group 21 male participants rated the "naturalness" of the observed scenes on a four-point scale while fMRI Neurally, the AON was preferentially engaged when processing contingent movement patterns, but did not discriminate between different degrees of movement fluency. In contrast, regions of the SNN were engaged more strongly when observing dyads with disturbed movement fluency Using the ratings of each as a parametric modulation of their general neural response to the stimuli, we found that an increase in naturalness experience was associated with higher activations in the AON. The SNN was preferentially recruited with a decrease in naturalness experience. In conclusion, while the AON is involved in the general processing of contingent social actions, irrespective of their kinematic properties, the SNN is preferentially when atypical kinematic properties prompt inferences about the agents' intentions.

What are they doing?: Comparison between actions facilitates memory for viewed actions

1

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Adults seamlessly recognize most actions they view, but how do they interpret and remember novel actions? We propose comparison is key. In the current study, adult participants viewed films in which they saw a hand act on a series of objects using unfamiliar tools (see Figure 1a). Participants in the *matching condition* (n = 12) viewed only the tool-use clips, whereas in the *alignment condition* (n = 11), they viewed the tool-use clips and hands acting in the same manner (no tool; see Figure 1b). The proportion of test trials on which participants remembered the tool that acted on each object differed between conditions (p = . 02; see Figure 2). Participants who viewed both tool-use and non-tool actions better remembered the relation between tool and goal-object than participants who saw the tool and object together twice as often. A recent study (Gerson & Woodward, 2012) found that, at an age when infants do not yet recognize the goals of tool-use actions, comparing tool-use actions with familiar, hand grasping actions helped infants later recognize and imitate the goal of tool-use actions. Together, these studies indicate that acting with others and comparing viewed actions can facilitate action interpretation and memory.

Three roles for social motivation in joint action

B

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The standard account of joint action has it that such action is principally facilitated by relatively cognitively demanding shared intentions and common knowledge. In recent years another hypothesis has attracted some economists, psychologists and philosophers, which is that a many of our social interactions may not principally driven by – or at least not merely by – agents intentions to achieve joint goals, but by *socially motivations*. As Adam Smith pointed out, human beings find acting with others pleasurable and rewarding in its own right. After considering some of the experimental and empirical work that seems to support this hypothesis, we ask: what is the evolutionary role for this social motivation in joint action? We suggest that there are three compelling answers to this question which supports a gene-culture co-evolution of social motivations and emotions: 1) Helping to facilitate the coordination and execution of things that might only be done by groups, or is more efficiently performed by groups; 2) Enhancing group formation and cohesion enabling the faithful cultural transmission of other traits; 3) Assisting the formation and maintenance of social bonds. While (1) can be seen as complementing the role of shared intentions in joint action, (2) and (3) rather suggest that shared intentions might be explanatorily redundant in many joint actions.

Cooperating brains: Dual-BCI as a new paradigm to investigate brain-to-brain coordination

I

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Recently, BCI research has started to provide new, elementary insights not only into brain control but also into the basis of neurocognitive processes. Here, we describe a novel BCI paradigm, 'Two-Person-BCI' or 'Dual-BCI', where the joint brain activity of two participants controls a computer. This can serve as a promising new research paradigm for the emerging field of brain-to-brain coordination (Kuhlen et al., 2012, Anders et al. 2011). The main hypothesis underlying this field is that people's ability to coordinate their brain activity forms the elementary basis for communication, thus creating a so-called 'shared space' (Gallese, 2003).

A key feature of our new Dual-BCI paradigm is that it allows people to coordinate their behavior without using muscular activity. Here, we will show why Dual-BCI is an especially promising paradigm for investigating brain-to-brain coordination, we will describe analysis methods that can be used to detect different types of neural coordination between brains, and provide preliminary results from a first experiment where the paradigm has been applied; see also the companion abstract (Schultze-Kraft et al.).

Children can solve coordination problems by using salience

2

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Humans are routinely required to coordinate with others (e.g. when navigating through traffic, meeting with friends). When agents have a common goal but must choose between multiple solutions without communicating (known as coordination problems, Schelling, 1960) adults often use salient cues in the environment to converge on a joint solution (e.g. going to the most prominent landmark when trying to meet a friend). Here we explored the development of this capacity by presenting dyads of 5- and 8-year-olds with a coordination problem: Two balls had to be inserted into the same of four boxes to obtain rewards. Identical pictures were attached to three boxes whereas a unique – and thus salient – picture was attached to the fourth. Children were either interdependent – they received one ball each and so had to choose the same box (experimental condition) – or independent – they received both balls and could get the rewards alone (control condition). In all cases, children could neither communicate, nor see each other's choices. Children in both age groups chose the salient option more often in the experimental than in the control condition. This study is the first to show that children from age five can achieve joint goals by coordinating on a salient solution.

Visual habituation: A window into the ontogeny of infants' understanding of cooperative action

L

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Cooperative activities in which individuals coordinate their actions to attain a common goal are fundamental to human cultural, linguistic, and behavioural systems. Children cooperate early in their lives. However, evidence that children cooperate does not confirm that they *understand* cooperation. A child who appears to cooperate by doing the right action at the proper time may do so based on learned contingencies (e.g., this is how this activity goes) rather than on a full understanding of the shared nature of the activity. The present research begins to fill this gap by using a innovative visual habituation paradigm, which uses infants' visual attention as a measure of their understanding of cooperation. By assessing infants' understanding of cooperation through their observations of, and not involvement in, cooperative actions, this paradigm addresses key limitations of previous work and allows testing of cooperative understanding at younger ages. We will present the findings of a series of studies investigating when and how 9- to 14-month-old infants come to understand the common-goal structure underlying cooperative action. Together, the results offer new insights into the ontogeny of an understanding of cooperation – a central component of human behaviour.

Development of turn-taking during infancy: Does the infant contribute?

L

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To develop into competent communicators infants need to learn to appropriately time their turns in social interaction. Few studies have assessed the actual timing of turn-taking in infant development and debate continues about whether infants actively contribute to the turn-taking. In order to assess whether changes in infants' vocal turn-taking abilities as they get older are really attributable to infants' improving skills, we analyzed video recordings of 12 mother-infant dyads in free-play interactions longitudinally at 12 and 18 months. Findings indicate that in the first half of the second year of life infants become more skilled in taking turns in vocal exchanges, as evidenced by decreasing onset times of their turns as well as a decrease in the percentage of onsets produced in overlap with their mothers. These changes are not explained by the mothers providing more opportunities to their infants to take their turn. The mean number of utterances produced by the mother did not differ significantly at 12 and 18 months, mothers did not shorten their utterances, nor did they increase the pauses between their consecutive turns. We therefore conclude that infants play an active part in vocal turn-taking exchanges with their mothers and its developmental progress.

Joint actions without intentions?

C

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Joint actions are usually explicated in terms of joint intentions. There is ample reason to believe, however, that some joint actions are unintended. Just as a single individual, a collection of individuals can, for instance, fail to execute its joint intention as planned and end up doing something else. Do joint intentions play a role in unintended joint actions? Chant (2006, 2007) has argued that they do not. Joint actions are instead to be individuated on the basis of their effects. I criticize Chant's account arguing that it fails to adequately distinguish joint actions from individual actions as well as from events that are not actions at all. On the alternative that I present, joint actions require joint intentions, but a joint action need not be based on a joint intention to perform that very action. I argue that, in addition to unintentional joint actions, there are unintended joint actions that are performed intentionally. I illustrate the significance of the resulting analysis by applying it in the context of collective responsibility attributions.

Multi-modal language comprehension as a joint activity: the influence of eye gaze on the processing of speech and co-speech gesture in multi-party communication

F

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Traditionally, language comprehension has been studied as a solitary and uni-modal activity. Here, we investigate language comprehension as a joint activity, i.e., in a dynamic social context involving multiple participants in different roles with different perspectives, while taking into account the multimodal nature of face-to-face communication. We simulated a triadic communication context involving a speaker alternating her gaze between two different recipients, conveying information not only via speech but gesture as well. Participants thus viewed video- recorded speech-only or speech+gesture utterances referencing objects (e.g., "he likes the laptop"/+TYPING ON LAPTOP-gesture) when being addressed (direct gaze) or unaddressed (averted gaze). The video-clips were followed by two object images (laptop--towel). Participants' task was to choose the object that matched the speaker's message (i.e., laptop). Unaddressed recipients responded significantly slower than addressees for speech-only utterances. However, perceiving the same speech accompanied by gestures sped them up to levels identical to that of addressees. Thus, when speech processing suffers due to being unaddressed, gestures become more prominent and boost comprehension of a speaker's spoken message. Our findings illuminate how participants process multi-modal language and how this process is influenced by eye gaze, an important social cue facilitating coordination in the joint activity of conversation.

Behavioural asynchrony taints the interaction context

N

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Behavioural synchrony, relative to asynchrony, appears to promote relationship-salutary outcomes (e.g., liking, cooperation We explored the possibility that these effects are driven by the deleterious of asynchrony rather than the beneficial effects of synchrony. Based on the assumption that individuals to expect social interactions to be smooth, we reasoned that synchrony might actually represent a psychological baseline for social interaction expectancies and that the experience of asynchrony might taint the interaction experience. Participants were exposed repeatedly to valence-neutral words and non-words on a computer while simultaneously finger-tapping in time with auditory cues presented via headphones. In the synchrony and asynchrony conditions, two participants performed the task together and were exposed to either synchronous or asynchronous auditory cues; in the control condition, participants took turns completing the task. Although participants' post-task ratings of the word stimuli did not differ as a function of condition presumably because of the words' pre-existing associations1), their ratings of the previously meaningless non-word stimuli supported our reasoning: in the synchrony and control conditions rated the non-word stimuli as valence-neutral, but participants in the asynchrony condition rated the same stimuli as negatively valenced (and as more negative than participants in the other conditions).

Wild interaction: Mirroring and coupled oscillation in self-sustaining systems

E

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Illinois State University

While ecological researchers conceptualize joint action in terms of self-organizing coupled oscillators, computationalists conceptualize it in terms of continuous, covert goal tracking. Wild Systems Theory (WST) reconciles these seemingly irreconcilable views by conceptualizing living systems as self-sustaining systems (i.e., the work they do at the chemical, biological, and behavioral levels, produces products that feed back into and sustain the work that produced the products). Such recursive work sustains stable system states, even in the face of perturbation. Thus, self-sustaining systems are inherently *goal directed* in ways that systems that are simply self-organizing, such as hurricanes and the rings of Saturn, are not. Given these multi-scale autocatatlytic systems emerge phylogenetically and ontogenetically out of the contexts in which they sustain themselves, they constitute embodiments of those multi-scale, phylogenetic/ontogenetic contexts. The largest contextual input into the self-sustaining dynamics of a developing brain is the body developing around it. Thus, the dynamics of the developing brain come to embody the spatio-temporal dynamics of a moving body. It should thus come as no surprise that brains resonate intensely to the spatial-temporal dynamics of other moving bodies. Thus, within self-sustaining systems, mirroring and coupled oscillation are basically the same phenomenon.

purpose of the present talk is to propose a potential a means of overcoming this rift. Specifically, it will be argued that while the ecological focus on dynamics is appropriate, its focus on *self-organizing* dynamics leads it to overlook important properties of *self-sustaining* systems; specifically, their ability to sustain stable system states (i.e., behave as if they have goals) in the face of perturbation. As for the computationalist camp, the notion of self-sustaining systems (versus computational systems) clarifies why brains express properties referred to as *mirroring*.

Learning together: Peer-scheduled practice is as good as self-scheduling

1

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Motor skill practice is often undertaken with others who share similar goals. In motor learning research, a random-schedule of practice (termed high contextual interference, CI) aids retention, yet when individuals can self-schedule, even if the schedule is low in CI, this practice is as good, or better, than random practice. We used a peer-learning paradigm to study this effect. Actors practiced 3 sequences of 5 key-presses with distinct movement time (MT) goals. Practice was either Self-scheduled with a passive observer, or Peer-scheduled (n=12 pairs/group). Though the Peer-schedulers chose a high CI schedule for their partner, in comparison to the Self-schedulers and switching between sequences was more dependent on MT error, the actors did not differ in retention. Later testing of the non-actor partners did not yield differences, although the Peer-schedulers adopted a high CI practice, which is considered more optimal. For both partners, Peer-scheduled practice was generally more motivating and enjoyable than self-scheduling with or without a passive observer. In view of the lack of difference in outcome data and the positive affect associated with peer-scheduling, we conclude that control over one's own practice is not a critical factor in optimization of practice, as long as practice is performance dependent.

Learning complementary action with differences in goal knowledge

I

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Humans, as a cooperative species, need to coordinate in order to achieve goals that are beyond the ability of one individual. Modeling the emergence of coordination can provide ways to understand how successful joint action is established. In this paper, we investigate the problem of two agents coordinating to move an object to one agent's target location through complementary action. We formalize the problem using a decision-theoretic framework called Decentralized Partially Observable Markov Decision Processes (Dec-POMDPs). We utilize multi-agent Q-learning as a heuristic to obtain reasonable solutions to our problem and investigate how different agent architectures, which represent hypotheses about agent abilities and internal representations, affect the convergence of the learning process. Our results show, in this problem, that agents using external signals or internal representations will not only eventually perform better than those that are coordinating in physical space alone but also outperform agents that have independent knowledge of the goal. We then employ information theoretic measures to quantify the restructuring of information flow over the learning process. We find that the external environment state varies in its informativeness about agents' actions depending on their architecture. Finally, we discuss how these results, and the modeling technique in general, can address questions regarding the origins of communication.

Intention- ought to be - naturalized

C

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Shared intentions are, arguably, the basic building blocks of human social cognition. A leading view in this field is the Shared Intentionality Hypothesis, SIH (Tomasello et al., 2005; Tomasello & Carpenter, 2007), according to which the cognitive achievements of human beings are made possible by the over-sophisticated capacity of our species to coordinate actions and plans over time. Humans possess a foundational skill which consists in the appreciation of the intentions of conspecifics, and then on the ability to share intentions on the basis of this appreciation. Ontogenetically, such capacity can be observed to emerge in prelinguistic children and – to some minor extent – in non-linguistic animals, primates, especially. And it gets fully developed with the acquisition of linguistic communication. This emergentist approach to the capacity of sharing intentions is based on the following assumptions:

P1) prelinguistic children share intentions
P2) conceptual thinking depends on language Then, C) shared intentions are non-conceptual.

However, I notice, the SIH relies upon a notion of intention that undermines its consistency: a notion that recalls Davidson (2001), Searle (1981) and Bratman (1987). These authors, in different ways, argued that concept mastery is required in order to articulate, to share intentions, and to coordinate actions and plans. This notion contradicts the assumptions of the SIH.

I argue that a we ought to understand the content of intention in terms of nonconceptual mental contenie, 2000; Bermùd ez, 2003, 2011; Hurley, 2003). I explain that (I) the SIH is the best account to pursue the process of naturalization of intention but (II) its consistency depends on the substitution of the current notion with the one that I present. This latter only can contribute to the theoretical clarity of the SIH, and to the process of naturalization of social cognition.

Reflections on mimicry from The Third Party perspective

D

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Despite the burgeoning literature on mimicry, work on mimicry perception is sparse. This brand of joint action signals rapport both to models and to third party observers of dyads. Less is known about how perceived mimicry effects wider aspects of social cognition or how, mechanistically, rapport judgments are made. Results of a research program that places participants in the role of third-party observers of mimicking dyads (or controls dyads) are discussed. This experimental paradigm has shown that mimicry of unfriendly others is interpreted as a lack of competence by third party observers, and that the impressions that third party onlookers form of mimics can be sensitive both to the reputation of their model and to whether the mimic shares the same information as onlookers. These results, coupled with wider theory, suggest that, to onlookers, mimicry is reflective of dispositions toward particular individuals, rather than as a signal of a stable pro-social disposition. Results also speak against the hypothesis that mimicry communicates similarity to the model. Rather, interpretations of mimicry's import are situated, but consistent with its status as an affiliation cue. Ongoing work also attempts to interfere with unconscious mimicry perception via manipulations borrowed from the embodiment and gesture literatures.

What can we learn from the mechanisms underlying joint thought in music performance?

I

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Orchestral musicians spend a lot of time practicing alone in order to perform with others. When they train, they attend to various aspects of their performance. An aspect has been defined as, "something a musician must attend to and make decisions about" while playing. While some aspects of performance have been identified in solo concert repertoire (e.g. Chaffin et al., 2002), to our knowledge, no one has presented a scientific account of the aspects of orchestral performance, neither in training, in rehearsal, nor in live performance. Orchestral performance is a quintessential joint activity. But how do instrumentalists train to perform jointly? What are the underlying mechanisms of joint thought in music performance?

To explore this problem we performed a microstudy of video masterclasses created to train advanced instrumentalists to audition for a position with a high profile orchestra. We were attentive to the variety of techniques, tricks, and ad hoc concepts the teachers used to get their students to attend to the right aspects. In this paper we explore the multimodal communications used to convey the concept of aspect – the attribute that a musician aims to change in practice, or convey in performance. We then move to a brief account of what we call incipient concepts – the early highly embodied concepts that emerge as an aspect comes into focus. Because of the complexity of the activity space, it is not always possible to directly state the target – the goal of a performance activity. In these cases, language does not fix the referent directly. Rather, it complements other activities that when performed, will lead to an understanding of the target. The analysis takes us one step toward an outline of the underlying mechanisms of joint thought in orchestral performance.

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Segregating my space from your space: Effects of physical separation on sequential modulations in a social Simon task

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When interacting with another person in a social Simon task a main difficulty for each person is to separate one's own actions from those of the co-acting person. The present study aimed to investigate if and how a physical segregation between both actors' action space modifies sequential modulations of the social Simon effect (SSE). Therefore, participants performed a social Simon task, a standard (two-choice) Simon task and an individual go/no-go task with and without a transparent curtain placed along the imagined vertical midline of the monitor. Separating space by a transparent curtain alters the size of the sequential modulation of the SSE in the social Simon task. The curtain manipulation had no effects in the standard Simon and the individual go/no-go task. The results are discussed in reference to conflict adaption and feature integration theories.

Believing versus interacting: Neural oscillations underlying interpersonal coordination

E

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When two people engage in a bidirectional interaction with each other, they use both bottom-up sensorimotor mechanisms such as monitoring and adapting to the behaviour of the other, as well as top-down cognitive processes, modulating their beliefs and allowing them to make decisions. Most research in joint action has investigated only one of these mechanisms at a time – low-level processes underlying joint coordination, or high-level cognitive mechanisms that give insight into how people think about another. In real interactions, interplay between these two mechanisms modulates how we interact with others. In order to tease these apart in a mutual interaction, we conducted a synchronization-tapping experiment using a 2x2 factorial design, where one factor was the auditory feedback (hearing other or computer), and the other was the belief of what they were hearing (other or computer). MEG was measured from one co-actor, with the other co-actor seated outside the scanner. Our findings show frontal alpha suppression during anticipation of the task with a person vs. a computer, and frontal-sensorimotor suppression during task execution with the person vs. computer. This provides insight into neural mechanisms underlying belief of interacting with another person as well as engaging in interaction with the responsive other.

Only joint actions with related objects induce to taking the object labels as conventional

2

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Young children can distinguish situations where a new word has conventional meaning from situations where it has only personal meaning for a speaker (Diesendruck, Markson, 2001). Previous research demonstrated the role of several cues in determination of a word conventionality: gaze direction (Henderson, Graham, 2005), linguistic forms (Diesendruck, 2005) and communicative context (Kotov, Vlasova, 2012).

We explain the effect of such cues by the inclusion of new words in differently structured joint actions. If the joint action is focused on between objects connection, new words will be perceived as elements of integrated shared knowledge (like a language) and taken as conventional. If the joint action is a series of separate operations, new words will be perceived as situationally shared knowledge and taken as unconventional.

We gave 2-4-year-olds geometric-shaped objects named by legend words. The joint action (game) was either focused on between objects connection or looked like a series of operations. We estimated which words children would use addressing to a stranger. 2-3-year-olds from the connected action condition use unconventional names (shapes), but children from the separate actions condition used the legend word (conventional naming). For the elder children condition difference was irrelevant so legend words were taken as unconventional.

Predictive representation of others' actions in a synchronous joint task: An EEG study

2

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Our objective was to seek for electrophysiological (EEG) evidence supporting the idea of parallel representation of one's own actions and of his/her partner's actions during the planning phase of a synchronous joint task. The experiment consisted of two participants planning and performing joint actions (i.e. synchronously lifting and clinking glasses), motorically similar, unimanual individual actions (i.e. lifting and moving a glass as if clinking with another person) and bimanual individual actions. We employed a choice-reaction paradigm where a visual cue indicated the type of action to be planned, followed 1.5 sec later by a visual go-stimulus prompting the participants to act. We focussed our analyses on the Contingent Negative Variation (CNV) due to its association to time representation and motor preparation. Our results showed that compared to planning a unimanual individual action, planning of the same action in a joint task elicited a larger CNV initially over lateral premotor areas associated with time representation and movement planning and later over supplementary motor areas assoxitaed , almost as large as planning a bimanual individual action. probably reflecting the increased coordination and the representation of the partner's action in the joint task.

Nonverbal responsivity in schizophrenia: An analysis of patients' social interactions.

G

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Patients with schizophrenia have difficulty interacting with others but the nature of this deficit remains unknown. Successful face-to-face interaction relies on partners' nonverbal coordination to regulate and manage conversation. For example, speakers and listeners frequently use head nodding to request and provide feedback without disrupting the verbal message. Patients with schizophrenia have difficulty interpreting nonverbal cues during 'off-line' social cognitive tests, but it is unclear if this translates to their 'on-line' interactions. This study investigated patients' nonverbal responsiveness through analysis of speaker and listener nodding during patients' social interactions.

Method: 3D motion-capture techniques recorded 20 patient (1 patient, 2 healthy-participants) and 20 control (3 healthy-participants) interactions. Healthy-participants were unaware they were interacting with a patient. Windowed cross-correlation analyses assessed coordination of nodding between the speaker and primary listener (identified by speaker gaze). Mixed model analyses compared coordination across conditions.

Findings: As listeners, patients' coordination with speakers did not differ from controls ($p>.1$). Compared to controls, listening patient group healthy-participants were more coordinated with patients ($p<.01$) and less with each other ($p<.01$). Thus, although patients display nonverbal responsiveness, others are detecting anomalies in the patients' behaviour, resulting in increased coordination with the patient to the detriment of coordination with each other.

Reading motor intentions during competitive interactions

1

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Recent psychological studies have demonstrated that reading intentionality is possible through the non-verbal observation of action in context (Stapel et al., 2012; Sartori et al., 2011). In the present study, our aim was to test whether humans could engage in joint-actions and read an agent's intention through the simple observation of movement kinematics of (1) the first element of a complex action sequence, (2) without any contextual information (body, head or gaze orientation). Results demonstrated that human agents are indeed able to distinguish above chance level between three different social actions. Eye-tracking analyses revealed that correct classification was performed on those trials characterized by anticipatory hand tracking (eye on object before the virtual hand). Using an artificial classifier (Artificial Neural Network), we revealed similar performance levels than that observed in human agents but furthermore reveled the importance of the first 500 ms of movement kinematics for correct classification. These results provide a better understanding of what would be needed for human agents for successful social interaction during joint actions and offer preliminary guidelines on how robotic adaptive controllers may be conceptualized in the future to afford biologically inspired social behaviors.

Specifying conditions for task co-representation

H

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Research on automatic imitation shows that the observation of another person's action leads to an internal activation of a corresponding motor representation in the observer. Joint action research suggests that we co-represent the action or task rules of a co-actor with whom we share a task when taking turns. We combined aspects of automatic imitation (online action perception) and joint action (turn taking) to test if task rule co-representation is more than just the activation of a co-actors action. When the co-actor was perceived from a third-person perspective responding to relatively arbitrary task rules, we observed an automatic imitation effect, but found no evidence for task rule co-representation (Experiment 1). When perceiving a co-actor who responded to relatively simple task rules and whose actions were shown from a first-person perspective, we found evidence for automatic imitation and for task co-representation (Experiment 2). Our findings suggest that depending on the exact task conditions, joint action can lead to task rule co-representation. The latter effect can be differentiated from online automatic imitation.

Movement synchronization under mismatched conditions

1

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Movement synchronization (MS) is a frequently emerging phenomenon connected to interpersonal sympathy, learning in early childhood and, by enhancing perceptual sensitivity and predictability, the increase of safety during interaction. These positive characteristics play a key role in the enhancement of safety and acceptance in human robot interaction (HRI). But as capabilities of humans and robots do not necessarily match, the question arises if MS is also possible under mismatched conditions, i.e. mismatched trajectories.

During the experiment, two people sat on a table, facing each other. The task was to repetitively tap two distinct targets with a pen in hand, while in half of the trials the trajectory of one participant was disturbed by an obstacle.

Analysis of relative phase distribution reveals that although movement trajectories differ, MS emerges. However, within the given time, it was harder to establish stable MS with an obstacle present. We found that differences in dwell times and velocity are responsible for this effect.

We conclude that MS emerges easily if own motor plans can be used for predicting the counterpart’s movements. Differing trajectories might require more information about the counterpart's behavior which possibly leads to misestimation complicating the emergence of MS.

The role of spatial correspondence parameters in the social transfer of learning effect

2

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Recent works indicated that performing a joint spatial compatibility task with an incompatible stimulus-response (S-R) mapping affects subsequent joint Simon task performance, eliminating the joint/social Simon effect (SToL effect). Crucially, the SToL effect was not tuned to the specific identity of the co-actor, and depended on the overlap between the spatial relations of the practice and transfer tasks. Starting from these findings, this study aimed at investigating which spatial relations between stimulus (S), response (R) or participant (P) positions are relevant for the SToL effect to occur. Two experiments were run in which the P-R associations were incompatible (participants were required to respond with crossed arms),whereas the S-R and S-P associations were manipulated. We found that learning derived from the practice task did not transfer to the subsequent task when S-R associations were spatially incompatible and S-P association were compatible (Experiment 1). However, a SToL effect was evident when S-P associations were spatially incompatible and S-R associations were compatible (Experiment 2), hence suggesting that the spatial relations between stimulus and participant positions is crucial for the SToL effect to occur, while those between stimulus and response positions are not.

Dynamics of Simon says: The structure of response behavior during joint-action

N

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Research investigating joint-action stimulus-response compatibility (JSRC) effects suggest that knowing what another person's task is during joint action is the means by which an individual can understand others' action intentions and points to *shared representations* as the basis of this integration or modulation process. Although this co-representation hypothesis is compelling, it remains unclear how these co-representational structures modulate the movement dynamics of ongoing joint activity. Here we present data from several studies that examined whether JSRC effects might also result from dynamic entrainment processes, whereby joint-action modulation is the result of the complex couplings that bind actors to each other and to their environment. Employing a number of standard joint stimulus-response compatibility paradigms (i.e., joint Simon type tasks), we examined the dynamic structure of joint response behavior using various fractal statistics and dynamical time-series methods. Collectively, the results imply that dynamical processes of entrainment may underlie some JSRC effects. They also highlight the complementary nature of dynamical systems and representational accounts, and we discuss this complementarily with respect to understanding joint cognitive processes.

Joint action with robots

K

Marsh, K. L., A. Bhat, T. Gifford, T. Davis, S. Srinivasan and M. Kaur

University of Connecticut, USA

Human-robot interactions provide an intriguing context for systematically examining the minimal conditions necessary for two "creatures" to engage in joint action—i.e., to become a cooperative and flexibly responsive social synergy of action. In this talk we present a theoretical perspective regarding what features would be essential for a human actor to perceive a robot as a potential social agent. We also present the results of two pilot studies that use such Gibsonian ecological principles in developing a child-robot intervention. These studies (one involving child-robot interactions, the other child-child-robot interactions) use the process of engaging in joint action with a robot (e.g., drumming, karate, dance, and yoga movements) as a means to improve the motoric and interpersonal skills of children. Typically developing children in these studies completed standardized measures of motioric skill, and measures of intrapersonal and interpersonal synchrony; spontaneous verbalizations were also assessed. Improvements in a number of dimensions (moderated for some mesures by social vs. solo context, and age of child) suggest robot-child interventions have exciting potential. This embodied, motorically oriented approach provides the grounding for a randomized control intervention currently underway designed to improve autistic children's motiric and social skills by using hild-r

Neural correlates of non-verbal social interactions: Insights from single & dual-EEG analyses

E

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Our study aimed at identifying neural markers of social interaction and context variations in a non-verbal task. We recorded dual-EEG and kinematics from an actor and an observer in a real face-to-face paradigm. The actor performed the same actions in an interactive or a non-interactive context (e.g the observer had to perform a complementary action or did nothing). We assessed the motor system activation via motor related potentials (MRPs) and beta oscillations of both participants. Inter-subject coherence was also measured to assess the relationship between the two partners' brains. Actor's movement kinematics did not differ in the two context conditions and its MRPs were similar. For the observer, however, observation-related MRP were more negative in the interactive context over fronto-central electrodes. Concurrently, suppression of beta oscillations was observed for movement execution (actor) and observation (observer) and was stronger in the interactive than in the non-interactive context. Additionally, in the beta band, the inter-subject coherence increased during interactive compared to non-interactive context specifically within centro-parietal electrodes. Therefore, acting in social context induced analogous modulations of motor and sensorimotor regions in observer and actor. Sharing a common goal during an interaction seems thus to evoke a common representation of the actio

Learning how to play together: Neural and behavioural processes of joint action in early childhood

K

Marlene Meyer, Harold Bekkering and Sabine Hunnius

Radboud University, The Netherlands

Young children's difficulties in acting jointly provide valuable insight in both, social-cognitive development and joint action mechanisms. In a series of experiments with toddlers, we investigated joint action performance and the potential functional involvement of the neural motor system. In a first behavioural experiment, we found that joint action coordination (timing variability & accuracy) improves considerably between 21/2 and 3 years of age[1]. Research with adults suggests that motor system activity might critically underlie successful joint actions[2]. Diverse functions have been related to the motor system: the execution and control of own actions as well as the monitoring and prediction of others' actions[2-4]. In an EEG study, we tested how toddlers monitor a joint action partner. The data show a context-specific involvement of the motor system during observation of an action partner which was related to the children's joint action performance[5]. In a third study, we investigated how inhibitory action control and action prediction are related to toddlers' joint coordination. The findings indicate a distinctive role of action prediction and inhibitory control for different aspects of action coordination (timing variability & accuracy). Together, these findings suggest that diverse functions of the motor system substantially contribute to developing successful joint actions.

[1] Meyer et al., 2010

[2] Bekkering et al., 2009

[3] Kilner et al., 2007

[4] Kourtis et al., 2010

[5] Meyer et al., 2011

Do 3-year-olds include a partner's task in their own actions? The emerging (social) Simon effect

1

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1 Radboud University, The Netherlands

2 Central European University, Hungary

We investigated the social influence on task performance (Social Simon effect, [1]) and its relation to individual task performance (Simon effect, [2]) in early childhood. We tested 3-year-old children in three conditions of a reaction time task (modified individual two-choice Simon task, Individual go/no- go task, Joint go/no-go task). Previous studies in adults suggest that performance in the Joint go/no- go task reflects that individuals include a partner □s task in their action planning and execution. We expected that toddlers would include a partner's task at approximately the same age when joint commitment develops in early childhood [3]. Results show that 3-year-olds responded faster to compatible than incompatible trials in the individual two-choice Simon task (i.e. Simon effect). However, there were large individual differences in their sensitivity to spatial compatibility. As expected, there were no compatibility effects in the Individual go/no-go task. Across all participants, there was no compatibility effect in the Joint go/no-go condition either. However, the size of the Simon effect was positively correlated with compatibility effects in the Joint go/no-go condition (Social Simon). The more sensitive 3-year-olds were to stimulus-response compatibility in their individual performance, the more likely they were to include their partner in their action planning and execution.

[1] Simon, 1990

[2] Sebanz et al., 2003

[3] Gräfenhain et al., 2009

Planning ahead for me and you? Higher-order action planning for individual and joint object manipulations

2

Marlene Meyer[1*], Robrecht P.R.D. van der Wel[2*] and Sabine Hunnius[1]

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Many daily actions involve multiple action steps. We investigated how far ahead people plan when performing such actions – either individually or jointly. Our set-up consisted of a simple object manipulation task in which objects with two grasping areas had to be placed on a target location with varying height. Participants were asked to pick up each object with one hand (using one of the two grasping areas) to subsequently pass it on to either their own hand (individual) or another person (joint) such that the object is finally placed onto the target location. The design implied that the first selected grasp determined the postures for the rest of the action sequence. By varying the height of the target location, we tested whether people planned ahead and modulated their grasp choices to avoid uncomfortable end-postures – for either themselves or their partner. Our findings indicate prospective planning for self and others, showing that individuals integrate the goal location of the whole action sequence in their planning irrespective of who performs the final action step. This third- order planning for self and others develops over time and appears transferable from individual to joint actions, suggesting a tight link between individual and joint action planning.

The sense of commitment

P

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Copenhagen University, Denmark

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The paper aims to establish the theoretical need for a minimal analogue of the concept of commitment, and to develop the notion of a sense of commitment as such a minimal analogue. The paper focuses on commitments within the context of joint action, i.e. within a context that is both fundamental and paradigmatic for human sociality in general. The paper articulates the functions that commitments fulfill, and thus also the functions that a minimal analogue of commitment should fulfill, as well as the demands that can be placed upon such a minimal analogue. In developing the notion of a sense of commitment as a minimal analogue, the paper focuses on emotions and action-related cues as constitutive components of the sense of commitment. Thus, it aims to conceptualize the link between commitment and emotion, and specifically to develop the concept of feeling committed as a component of the sense of commitment. Furthermore, it aims to conceptualize the link between habitual interaction patterns and commitment, and to develop the concept of acting committed as a further component of the sense of commitment.

Dialogue in joint activity: coordinating on referring intentions and plans

J

Gregory Mills

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One of the most contentious debates in studies of dialogue concerns the role of intentions. Intentionalist post-Gricean accounts explain coordination as being underpinned by the formulation and recognition of speakers' intentions. By contrast, empirical approaches present a more nuanced view: intentions, plans, and beliefs are treated as joint construals (Clark, 1996) that are emergent from the interaction.

To investigate the role of intentions in coordination, we report a variant of the "maze task" (Pickering and Garrod, 2004).Participants communicate via an experimental chat tool (Mills and Healey, 2006), which interferes with the unfolding dialogue by inserting artificial clarification requests that appear, to participants as if they originate from each other. Two kinds of clarification request were introduced: (1) Artificial "Why?" questions that query the participants' plan, (2) Fragment clarification requests (Healey et al 2003) that repeat a single word from the prior turn, querying the referring intention.

As coordination develops, interlocutors respond differently to both kinds of clarification request: "Why?" clarification requests become progressively easier to respond to, while for fragment clarification requests the converse is the case. We show how this differential pattern is not arrived at via explicit negotiation, but through the tacit turn-by-turn feedback mechanisms of dialogue.

The development of co-representation effects in a joint task: Do children represent a co-actor?

K

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The current study investigated whether co-representation effects (Sebanz, Knoblich & Prinz, 2003) can be observed in 4-5 year-old children. In Experiment 1, two children performed a task based on the Bear Dragon task (Kochanska, Murray, Jacques, Koenig & Vandegeest, 1996), where children were required to point to a picture when instructed by one of two puppets and inhibit pointing when instructed by the other. In the Joint Task condition, each child in a pair had to perform a different task rule, whereas in the Same Task condition, they both performed the same rule. Children made more errors in the Joint Task condition than the Same Task, suggesting they were experiencing interference from their partner's rule. Experiment 2 replicated these findings and added a switching dimension, where half way through participants had to swap to the alternative rule. Participants showed less of a switch cost in the Joint Task condition than in the Same Task condition. This provides further evidence that they were representing their partner's task rule, as previous representation of the alternative rule meant they were not switching to something entirely novel. This highlights a potential mechanism that may explain children's apparent joint action abilities at a young age.

The effect of action on aggregate pattern perception in a music ensemble

1

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Performing music is complex. Especially for beginners the motor action should be demanding. Consequently, in a music ensemble limited attentional resources are available for perceiving the aggregate of the individual parts and, thus, for adequate music performance. In the present study, the mental and motor components of an action were simulated in a 2 x 2 between-subjects design. Stimuli were aggregate rhythmic patterns. Subjects either had to passively listen to the aggregate pattern, or to tap with a composing pattern of the aggregate pattern. At the same time, subjects either heard the whole aggregate pattern, or they had to imagine the composing pattern. After this, participants had to indicate whether a second aggregate pattern was identical to or different from the first one. Results showed that actual performance of an action and mental imagery had a detrimental and additive effect on aggregate pattern perception.

Generalized synchronization by acoustic stimulation in football

2

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The performance of a football team strongly depends on a precisely timed interplay. In an experimental study we tested whether the collectivity of a team can be altered when the players are subject to a persistent musical beat as a common external time-reference for individual action coordination. Equipped with earphones and potable receivers randomly chosen teams of 5 experienced players performed 3*10-minutes matches on a reduced football-field under following test conditions: 1) team A was supplied a synchronous stimulus (140 bpm in phase synchrony), team B an asynchronous stimulus (5 different tempi between 119 and 168 bpm) 2) in reverse 3) both teams without stimulus. The order of the three conditions changed between the measurements. People unconsciously tend to adjust their movements to external rhythms.* Thus we hypothesize that the collectivity of synchronously stimulated teams increases. A non-parametric pair statistic was designed for a quantitative comparison of condition 1) and 2) based on the number of passes, number of ball contacts and the number of pass- -chains. Condition 3 served as significance level. Male teams showed an extremely significant (P<1%) increase of collectivity under synchronous condition. Surprisingly, female players did not show any effect at all. Results are interpreted via the concept of generalized synchronization**, where the players are understood as coupled complex dynamical systems.

* e.g. MacDougal et al., J. Appl. Physiol, 2005 ; Styns et al., Hum. Mov. Sci., 2007

**Rulkov et al. , PRE 51, 1995

Seating arrangement in two-dimensional joint Simon task

2

Akio Nishimura[1], Kazuhiro Akimoto[2] and Kazuhiko Yokosawa[2]

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[2] The University of Tokyo, Japan

When two individuals seated side by side engage in separate but complementary go/no-go tasks (e.g., left participant presses the left button to one color, and right participant presses the right button to the other color, of the target presented on left or right side), performance is better when the target and the response button are on the same side (joint Simon effect). The present study investigated the influence of the participants' seating arrangements on joint Simon effect. Seating arrangement was either side by side, face to face, or with 90-degrees angle. The stimuli were projected to a mirror on the tabletop. Target was green or red and varied along horizontal and depth dimensions simultaneously. Two response buttons were diagonally arranged. One participant pressed one button to green target while the other participant pressed the other button to red. Joint Simon effect was present for horizontal dimension but was absent for depth dimension regardless of the seating arrangements. When a single participant engaged in two-choice version of this task, Simon effects emerged for both dimensions, and they were of similar magnitude. This discrepancy in terms of right-left prevalence suggests different representations for single and joint Simon tasks.

Motor simulation and perspective taking mediate the co-representation and temporal integration of self and other in joint action

M

Giacomo Novembre and Peter E Keller

Max Planck Institute for Human Cognitive and Brain Sciences, Germany

Successful joint action requires the simultaneous representation of self- and other-related behaviour, and their integration in (real) time. Here we used a musical paradigm to investigate the role of motor simulation and perspective-taking skills (PTS) in mediating these functions in the interactive brain and behaviour. In a first (single-pulse) TMS study, we found evidence that musicians co-represent the actions of their co-performers using motor simulation processes, and that these mechanisms are particularly enhanced in individuals with high PTS. In a second (repetitive) TMS study, we show that interfering with motor simulation of another's action impairs one's ability to coordinate with it in real time, and that this interference is stronger in individuals with high PTS. Finally, we provide evidence of how motor simulation and PTS modulate reciprocal adaptation (at a millisecond time scale) in a task requiring interaction between two musicians. Taken together, the results suggest that motor simulation and perspective-taking traits mediate co-representation and temporal integration of self and other in joint action.

Commitments, predictability and joint action

P

Elisabeth Pacherie

Institut Jean Nicod, Paris

There are important divergences among philosophers on the nature and role of the commitments present in joint action. Some hold that joint commitments, together with the mutual obligations and entitlements they entail, are constitutive of shared intentions and engage a *sui generis* form of social normativity. Others maintain that while mutual obligations and entitlements are very common in joint action, they are not essential to joint action. In this talk, I shall approach these issues by considering the function of commitments in joint action. Success in achieving a joint goal rests on the coordination of co-agents' intentions and actions and successful coordination itself depends on the predictability of one's co-agents decisions, intentions, and actions. I shall argue that the chief role of commitments in joint action is to make oneself more predictable to one's partners. One corollary of this would be that commitments are only necessary to the extent that predictability cannot be achieved (in a cheaper way) by other means. Another corollary is that commitments in joint action have an essentially social dimension since their function is to make oneself predictable to *others*.

Bottom up development of a robot's basic socio-cognitive abilities for joint action

1

Amit Kumar Pandey, Aurélie Clodic, Lavindra de Silva, Severin Lemaignan, Mathieu Warnier and Rachid Alami

Université de Toulouse, France

Inspired from child development and behavioral research, we identify and equip our robots with basic yet key socio-cognitive capabilities for joint action:

1. Perspective Taking: Reasoning about abilities to reach and see some place or object from others' perspective. These are central for deciding the "what", "where" and "how" aspects of joint action.

2. Affordance and Effort Analysis: Reasoning about "what" an agent can afford to do with an object and for other agents, and with "which" effort levels. These are important for planning joint actions.

3. State Analysis: Analyzing the current physical state of an agent, e.g. whether holding something or free, looking around, or focusing on something. These are important for executing and monitoring a joint action.

4. Planning Basic Joint Tasks: Planning day-to-day tasks, e.g. giving, showing, or hiding some object, by taking into account how to grasp the object so that the other agent can take it, how to hold/place it so that the other agent can recognize it. These are important for the success of the joint action.

5: Proactivity for Joint Tasks: For common tasks like 'give' or 'make accessible', it helps if the receiver agent proactively reaches out to take, or suggest where to put. We found that such proactive behaviors reduce the effort and confusion of the human partner in the joint action.

We claim that these altogether greatly elevates the robot's collaborative and joint task planning and executing capabilities towards being socially acceptable.

Coordination games and joint actions. A look into the interactions between different levels of coordination

B

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In order to produce a joint outcome, the ability to coordinate our action with those of others we are interacting with is a crucial issue. As pointed out by Knoblich, Butterfill & Sebanz (2011) coordinating one's action with others "seems to require some kind of interlocking of individuals' behaviors, motor commands, action plans, perception, or intentions." But interlocking behaviors clearly differs from the interlocking of action plans or intentions, so we can set a distinction between a low-level coordination, concerning motor representation, and the management of action plans and intentions which lead to some high-level forms of coordination. Then, once we've settled this distinction, we have to face a new challenge concerning whether and how low-level and high-level forms of coordination really interact. How is this interaction possible? How does it work? Do low-level forms of action coordination somehow constraint high-level forms of action coordination? And, in particular, could the latter modulate the former in a top-down way? The aim of my work is to point out that the form of high-level coordination which is found in the one formalized by Game Theory could be relevant for this issues. I claim that it is worthwhile to investigate whether mutual expectations, intentions and representations about the partner's task, as used in Game Theory or in other common coordination problems, have an effect in the representation of motor outcomes and action understanding in different kind of joint actions.

Constraints on joint action

A

Cedric Paternotte

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There exist many competing philosophical definitions of joint action and no clear criteria to decide between them; so far the search for definitions has by and large been a semantical enterprise rather then an empirical one. I here investigate and assess several constraints that could help converge towards a set of necessary and sufficient conditions for joint action. The *tightness* constraint favours definitions that fit joint actions in which the links between agents are as relaxed as possible, so as to better pinpoint the conceptual core of jointness. The *cognitive* constraint asks for definitions based on realistic psychological states, so that they fit normal human beings. The *motor* constraint holds that definitions should refer to psychological mechanisms involved in actual human coordination. I discuss and dismiss these first three constraints, mainly because they manage to establish vague limits at best (for various reasons). I then introduce a fourth one, the efficiency constraint, based on the fact that most of our joint actions are generally successful, and according to which definitions should involve conditions that help justify this success. I defend it against objections by distinguishing between its rational and evolutionary versions, for both of which I provide examples.

The influence of communicative intent on the form of pointing gestures

1

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In everyday communication, pointing gestures are often used to establish triadic joint attention on a referent. Although such pointing is generally considered a joint action, it is unclear whether and how characteristics of the joint act shape the physical form of the gesture. The present study manipulated the gesturer's communicative intent as one possible factor influencing the form pointing gestures take, by varying the gestures' informativeness.

Twenty-four participants pointed for a confederate addressee at one of four circles that lit up on a computer screen, while three-dimensional hand movement kinematics were recorded. The addressee looked at a corresponding screen and either saw the same circle light up or did not see a circle light up, rendering the participant's pointing gesture either redundant or informative. In the informative condition, participants significantly lowered the velocity of the gesture's stroke and prolonged the duration of its post-stroke hold-phase.

In line with findings on actions like reaching and grasping (Sartori et al., 2009) and the spontaneous production of iconic co-speech gestures (Gerwing & Bavelas, 2004), the form a pointing gesture takes thus depends on the context-bound communicative relation between gesturer and addressee.

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Perception of collaboration in joint musical performances

2

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Humans are exquisitely sensitive to social signals and interactions. This study explored human sensitivity to social interactions in a setting that is non-verbal and yet demands a high degree of interaction. Ensemble jazz musicians are remarkably adept at working together to produce music that is more than the sum of its parts. Listeners claim anecdotally to hear when the musical ensemble is 'in the groove,' but there is little data. We employed jazz-standard duets varying in the opportunity for collaboration (two-way, one-way, none), to test listeners' perception of collaboration. The same tracks of individual instruments appeared in all three conditions, isolating collaboration as the critical variable. In experiment 1, 70 participants listened to random selections from these recordings and rated them for synergy, creativity, emotionality, and engagement. Results showed considerable sensitivity to collaboration, with sensitivity varying both with social intelligence and musical training of the participant. In experiment 2, 36 participants made explicit judgments of whether the selections involved collaboration, with the results showing they could not. We conclude that the degree of collaboration in joint musical performances influences the implicit experience of listeners, but is not accessible for explicit judgments.

Sensorimotor communication: a theory of signalling in online social interactions

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The study of human communication has principally focused on the interplay between language, gestures and deictics. In online social interactions these forms of communication are however complemented by another kind of (sensorimotor) communication: signalling. For example, while we move a table together, I can push it in a certain direction to signal you where I want it to be placed. Other examples of signalling are over-articulating words in noisy environments and over-emphasizing vowels in child-directed speech. In all these examples, humans intentionally modify their action kinematics to make their goals easier to recognize. We present a formal theory that describes signalling as a combination of a pragmatic and a communicative action and explains how it simplifies coordination in online social interactions. According to the theory, signalling requires solving a trade-off between the costs of modifying one's behaviour and the benefits in terms of interaction success. Signalling is thus an intentional strategy; it acts in concert with automatic mechanisms of resonance, prediction, and imitation, especially when the context makes actions and intentions ambiguous and difficult to read. The study of signalling provides an excellent opportunity to understand the adaptive (and evolutionary) value of communication in terms of coordination and interaction success.

The development of purposeful intersubjectivity

K

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An increasing number of research seems to confirm the existence of low-level automatic mechanisms that allow humans to imitate and synchronize their actions (Rizzolatti & Craighero, 2004; Schmidt & Richardson, 2008). However they are not sufficient for the explanation of how purposeful, goal-directed, intentional coordination arises (Marsh et al., 2006; Fusaroli, et al., 2013). Some theorists thus propose higher-level cognitive mechanisms, such us "understanding" the actions of others, "representing" them in terms of others' intentions, mind-reading capacities, construction of predictions of the others' behaviour, etc. Yet in the search for mechanisms enabling joint action, one should start by analyzing closely early mother-infant interactions to assess to what degree the capacity for joint purposeful activity might be due to simpler processes. In this paper we "slowed down" the episodes of early mother-infant interaction and performed analysis of multimodal behaviours that comprise them. We show how initial, perhaps automatic movements are gradually and age-dependently tuned to become "acting with others", i.e., we show how the child's actions acquire both individual and systemic (dyadic) meaning. We conclude that before evoking abstract higher-level cognitive representational processes one should acknowledge that the bases for purposeful intersubjectivity lay in shaping, in repetitive interactions, individual behaviours and automatic alignment into meaningful collective events.

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Scaling-up perception-action links: Evidence from synchronization with individual and joint action

O

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How do we map joint actions we participate in onto joint actions we observe others performing, such as when a couple dancing tango observes another couple dancing tango? We investigated this question using a task where participants were instructed to perform individual or joint movements in synchrony with individual or joint movements observed on a computer screen. The observed movements started slowly and then continuously increased in tempo (from 1.75 Hz to 3 Hz). The results showed that, with regard to spatial parameters, joint performance was more accurate when observing joint performance than when observing individual performance. Individual performance was more accurate when observing individual action than when observing joint action. There were no systematic differences with regard to timing parameters. These results suggest that mechanisms of temporal coordination may be less susceptible to differences between individual and joint action than mechanisms of spatial matching.

Synchrony, shared intentionality and cooperation

2

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Collective music and dance is a specific form of joint action found cross-culturally. Compared to other forms of joint action, music and dance is particularly puzzling as there is usually no obvious utilitarian function for its performance. One theory for why music and dance exists is that it promotes cooperation. The matching of rhythmic behaviour between individuals (synchrony) has been highlighted as one mechanism through which music and dance could facilitate cooperation. However, collective music and dance also typically involves shared intentionality. We examined over three experiments if synchrony is sufficient to increase cooperation or if shared intentionality also plays an important role. We compared conditions in which participants had a shared goal to create synchrony or asynchrony to conditions in which synchrony or asynchrony were created as a by-product of hearing the same or different rhythmic beats. Across all three experiments we found that synchrony combined with shared intentionality produced the greatest level of cooperation. Path analysis supported a model by which perceiving synchrony provides immediate feedback for successful cooperation so reinforcing the group's cooperative tendencies. Our findings suggest that action and perception systems combine with social and intentional systems to evoke especially powerful cooperative responses.

Experiments in dynamic group action and decision making: How crowds of people can walk a tightrope together and survive a zombie attack

O

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We present results from a new paradigm: mass participation games. In our experiments, hundreds of people can play a computer game simultaneously using audience response handsets. We can collect responses from a lecture hall full of people with the precision of a laboratory cubicle. We have studied two games: continuous, action games where participants cooperate to achieve a goal; and decision-making paradigms in which participants make repeated choices to maximise their own or the group's rewards. We address a range of theoretical questions with experimental manipulations and computer modelling. Does the size of the group influence the group dynamics? How are participants learning about each others' behaviour and shaping their actions? Do participants play as if they were alone, or as a group? If so, do they represent the group as a single entity, or a collection of other agents? What are the dynamics of these behaviours, with learning across many trials? Lastly, we are interested in the social phenomenology of group dynamics. What social forces might shape group cohesion? How does it feel to be part of a successful, coordinated group?

It ain't what you do, it's the way that you do it: contingency and similarity in behavioural coordination

Victoria Sinclair, Nicola Webb, Nick Duran and Daniel C. Richardson

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When two people interact, they coordinate their behaviour and mimic each other, producing feelings of affiliation. We contrasted two components of this coordinated behaviour that are usually conflated: the similarity of actions, and their contingency. In our first study, pairs of participants were video-taped during a conversation. We quantified motion in their upper and lower bodies. Cross recurrence analysis showed that there was greater coordination between different parts of their bodies as there was between the same parts of their bodes. In the second experiment, participants tapped along to a metronome. They either tapped with the same or different foot/hand action as a confederate. In the contingent condition, there was a single metronome and each tapped when it swayed towards them. In the non-contingent condition, there were two metronomes, and each tapped on alternate beats. Even though they were producing and hearing the same taps in each case, positive ratings were higher in the contingent condition alone. In natural social interactions and experimentally controlled tasks, we observed that contingency, not similarity, was the key component of behavioural coordination.

How small-scale interactions can exercise large-scale effects on language: An experimental test of two models of new-dialect formation

J

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Repeated small-scale interactions between individuals can exercise large-scale effects on cultural entities. One such effect is the divergence of languages into dialects. There is more than one explanation for why this occurs. The null model suggests that, because speakers interact linguistically more with some people than others, social groups come to share linguistic variables. Over time, with the accumulation of random changes, groups move apart linguistically from other group.

However, because social groups can use linguistic variables as identity markers, between-group competition might be expected to speed up this process, as speakers actively select some linguistic variables and reject others during interactions.

Here I present an experimental study in which participants played an anonymous game using an instant-messenger-style program and an artificial ‘alien language’. The competitiveness of the game and the frequency with which players interacted were manipulated in a 2x2 design. Given frequent enough interaction with team-mates, players were able to identify themselves linguistically. In the most competitive condition, this led the language to diverge into dialects, which did not occur in other conditions. This suggests that both frequency of interaction and a pressure to use language to mark identity play a significant role in encouraging rapid linguistic divergence, but that neither is sufficient on its own.

Breathing in human interactions

1

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Breathing is a biological rhythm that is sensitive to human interaction at various levels (e.g., linguistic structure, speech production, perception, emotion, cognitive load). For instance, it has been shown that breathing is synchronized among dialogue partners at the time of turn taking. However, it is unclear, whether humans engaged in a conversation synchronize their breaths throughout the dialogue or only at certain time windows. Furthermore, it has never been shown whether breathing behaviour among partners involved in conversations mirrors their social interaction and is specific to the respective dyad.

This study does a first attempt to answer these issues. It investigates the inter-personal coordination of breathing in face-to-face communication. Ten female German participants were involved in two successive dialogues with two different females (the experimenter and her colleague). Rib cage and abdominal breathing kinematics have been recorded by means of two Respitrace systems. Currently, an analysis of breathing kinematics, a linguistic analysis and an analysis of the similarity in breathing behaviour are carried out. We will discuss our analyses with respect to the hypothesis that breathing coordination could be a physiological support of interpersonal alignment in dialogue.

Is joint-action synergistic? A study of the stabilization of interpersonal hand coordination

1

Veronica Romero and Michael J. Richardson

University of Cincinnati, USA

The human body is an extremely complex system that needs to be adaptively coordinated to perform functional motor activities. A number of theorists have argued that the intrinsic bio-dynamics of the human perceptual-motor system is coupled to the physical and informational dynamics of the task environment and that this coupling operates to constrain the high-dimensional order of the human movement system into low-dimensional task-specific synergies. It has also been argued that the coordinated motor control that takes place during joint actions might also be synergistic. Here we present data from a joint-action task in which two participants were instructed to bring their hands together to connect a pointer and a target—one participant held and moved the pointer and the other the target. To assess whether the joint action behavior formed a true synergy, two hypotheses were tested using the uncontrolled manifold (UCM) analysis: (H1) the target and pointer position are stabilized by a non-additive interaction of both arms (interpersonal synergy); (H2) the target position is stabilized by each participant controlling their arm joints in a coordinated but additive manner (two coordinated intrapersonal synergies). The results confirm H1 and provide the first direct evidence that effective joint-action behavior is synergistic.

Capturing social motor coordination: Comparing the Microsoft Kinect Video Analysis and Wireless Motion Sensor Tracking

2

Veronica Romero[1], Mary Lauren Malone[1], Paula Fitzpatrick[2],

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Recent advances in video camera technology and computer hardware have resulted in a number of low cost gaming systems for remotely tracking human motor behavior. Companion open source code and software development kits that enable the development of recording and analysis software that meet the specific needs of researchers interested in obtaining wireless time-sires recordings of human movement has also made it much cheaper and easier to collect such data. The degree to which these systems can replace expensive 'high end' motion tracking systems, however, is likely to be task and behavior dependent. For instance, differences in the spatial and temporal resolution of low cost systems in comparison to high-end laboratory grade systems could significantly influence the outcome of study. Here we present a comparison of video and skeletal data recorded using the Microsoft Kinect to data obtained using modern video analysis algorithms and data recorded using a high-end Polhemus Latus wireless motion tracking system. By comparing data recordings of various intra- and interpersonal motor coordination behaviors obtained from a study on social motor coordination in typically developing children and children with ASD, we objectively detail the effectiveness of each system for studying joint action and social motor behavior.

When do people not add a verbal component to their requests?

2

Giovanni Rossi

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Requesting is a particular form of joint action in which an individual uses their voice and/or their body to get another individual to carry out the means towards a certain goal. This study is part of a larger project aimed at describing the functions of different communicative resources employed by speakers of Italian to do requesting in everyday face-to-face interaction. Its present goal is to describe the interactional conditions under which speakers choose not to add a verbal component to a request, and to rely exclusively on bodily actions to accomplish it (e.g., holding out an object or reaching out for one). In a corpus of video- recorded spontaneous interaction, over 90% of nonverbal requests (n=141/155) are made within a pre-structured activity, such as playing cards or distributing food at the start of a meal. Nonverbal requests are functional to the progression of such activities and concern routine steps that are preordained by their structure. I show that, for a request to be successfully made nonverbally, its goal has to be predictable by the recipient. In such an interactional environment, minimizing the communicative resources used to construct the request (i.e., omitting the verbal component) is motivated by both informational and affiliational principles.

Racial bias modulates joint-actions with ingroup vs outgroup avatars

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Racial bias strongly influences the way people categorize the social world. We investigated whether implicit bias impacts on joint-action kinematics during a purely motor realistic interaction. Caucasian participants were required to perform synchronous reach-to-grasp movements with outgroup (black) or ingroup (white) avatars. Crucially, the two avatars moved with identical kinematics. The hand grip-aperture kinematics of each participant was recorded during the interaction. The design included: i) *Timing interactions*, which required participants to be synchronous with the avatar; ii) *Adaptive interactions*, which required participants to be synchronous and to adapt to the avatars' movements performing complementary or imitative actions. In 33% of the trials the avatars "tried to trick" the partner performing a movement correction.

Results showed that the general level of performance was unaffected by the avatar's physical appearance. However, participants achieved better performance during Adaptive as compared to Timing interactions only when interacting with the ingroup partner. Moreover, only the interaction with ingroup partners induced mimicking effects that correlated with the individual implicit ingroup preference as measured by the Implicit Association Test. Altogether, our results show that implicit categorization of the partner as an "outgroup" strongly influences joint-actions features, modulating the embodied resonance with the partner's movements.

Motor cortex excitability: dissociating simulation and reciprocity

H

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It is well known that perceiving another's body movements activates corresponding motor representations in an observer's brain. It is nevertheless true that successful interaction often requires complementary rather than emulative movements. We showed that the automatic tendency to 'mirror' other's actions become the inclination to perform an appropriate complementary action, when needed. Is the simulative mechanism overwritten by the complementary one? Or do they work side-by-side? By using single-pulse transcranial magnetic stimulation and electromyography, we tested the coexistence of simulation and reciprocity in the corticospinal activity of participants observing a model performing a penalty kick towards them. Crucially, the observers reported the feeling of being hit by the ball and the need to parry it. Observing this action engendered a 'mirror' effect in the participant's legs and a reciprocity effect in their hands. Control conditions in which they observed the same action but in a context not implying a complementary request were included (e.g., a penalty kick without ball). The results provide compelling evidence that observers keeps simulating the model's movement while preparing an appropriate, complementary gesture. Modulation of corticospinal excitability appears to be a reliable measure of the coexistence of simulative and complementary mechanisms in the human motor system.

Sensorimotor predictions and self-other recognition in robotics

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Being able to distinguish between self and other is a prerequisite for successful joint action. Such an ability requires a basic understanding of ourself and how we interact with the world. To achieve this, we seem to rely on very finely tuned models of our sensorimotor capabilities, which are involved in the control of our actions as well as in the prediction of their sensory consequences. These predictions are what is thought to underly our sense of ownership, and thereby provides us with a means to recognize when actions are performed by others.

The research reported here relates to the use of internal models for self-other distinction in robotics. We demonstrate how a humanoid (Nao) robot, which acquires a sensorimotor scheme through self-exploration, can produce and predict simple trajectories that have particular characteristics. The errors that arise from predicting observed actions with one's own sensorimotor system is what could be used for self-other distinction. Preliminary results show that the mean prediction error when the Nao robot observed its own movements was smaller than when observing a Puma robot. This is consistent with the self-advantage typically observed in prediction and recognition experiments involving humans.

Does motor synchrony really create interpersonal cooperation?

2

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This study aimed to determine whether underlying factors such as interpersonal attention and mood contributed to Wilthermuth and Heath's (2009) finding that that interpersonal motor synchrony increases cooperative behavior. In a hand clapping condition, participants played a hand clapping signaling game that required motor synchrony. In another condition using a metronome, subjects played the signaling game that required them to attend to one another without hand clapping. In a hand clapping video condition, participants watched a video of people playing the hand clapping game to induce a positive mood. In the homework video control condition, participants watched a video of people doing homework. Subsequently, participants played the Public Goods game that measures interpersonal cooperation. Results revealed that the hand clapping condition exhibited the most cooperation followed by the metronome condition, homework condition, and hand clapping video condition. Follow-up tests suggested not only that motor synchrony seems to contribute to the cooperation observed more than mood but also that motor synchrony might just be a vehicle for enhancing interpersonal attention. Overall, the results seem to verify the findings of Wiltermuth and Heath and enable us to better understand the factors that might contribute to the relationship between interpersonal synchrony and cooperation.

Strategic reduction of variability for joint action coordination

2

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When coordinating an action with another person, we often rely on feedback from our partner in order to adapt our own part of the action. This in turn facilitates reaching the desired joint outcome.
However, how do we achieve joint action coordination in the absence of such feedback? In the present study, pairs of participants performed a real-time coordination task in which they each moved a computer mouse towards a target displayed on a screen. Their joint goal was to arrive at the target synchronously. We hypothesized that co-actors would strategically reduce the variability of their actions to achieve synchronization. In line with our predictions, participants moved less variably, in this way contributing to interpersonal coordination by making their own actions consistent and thereby predictable. This strategic reduction of variability can be described as a general coordination strategy: When lacking real-time information about a co-actor's action, strategically adapting one's own action proves to be a successful mechanism for joint action coordination.

Cooperating brains: Joint control of a Dual-BCI

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Despite abundant research with non-invasive Brain-Computer Interfaces (BCIs), multi-brain BCI studies (BCI applications involving multiple users simultaneously) are scarce. The few multi-BCI studies that have been conducted involve two participants individually controlling a separate part of an application (e.g. 'Brain-Pong', Müller et al., 2006). To the best of our knowledge, the present study is the first one investigating a cooperative BCI scenario, in which two participants jointly play a computer game cooperatively controlling a single game character using EEG-based motor-imagery BCIs.

Here, we present first results on the feasibility & user experience of jointly and continuously controlled BCI applications. We give a detailed description of the Dual-BCI setup, the design of the BCI game, potential caveats and possible improvements. Furthermore, we compare the classifier outputs from both players and explore the integration of both participants' brain signals for multi-brain classifiers. In addition to the development of BCI games, one interesting application scenario for the Dual-BCI setup is its ability to serve as a framework for investigating neural brain-to-brain connectivity of inter-personal interaction: Using BCIs to control computers via brain activity alone, people can perform coordinated behavior without any muscular activity (see companion abstract Görgen et al.).

Giving a mug to you, when your coffee and your eyes ask for it

1

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Though many empirical and theoretical works underlie the role of context in affordance perception, the contemporary debate lacks of a systematic analysis of the influence of *social* context. We investigated how an agent's reach-to-grasp movement towards a target-object (*mug*) is influenced by the interaction with another person.

The experimenter moved or used an object (manipulative/functional grip). The participant had to catch a second object, to give it to the experimenter or to move it towards her own body (GIVING/GETTING). The two objects were linked by a spatial (*mug-kitchen paper*), a functional-individual (*mug-teabag*) or a functional-cooperative relation (*mug-teapot*). The communication between the experimenter and the participant could/could not be conveyed by eye-gaze.

GIVING and GETTING manipulations modulated participants' intentions: for the *giving* response, looking at an interaction with the object in accordance with its conventional use anticipated the maximal fingers' aperture. Moreover the visual contact and the objects' functional-individual relation affected the reaching component of the movement, inhibiting response in the *getting* condition.

Results show that we are sensitive not just to the physical context but also to the social one, as we extract intentions of others from both their hand-posture and eye-gaze. Both indexes are modulated by our current intention.

When task sharing eliminates interference: Evidence from the joint Picture-Word interference paradigm

2

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The joint version of the picture-word interference (PWI) paradigm was employed to investigate how people can deal with the task irrelevant information when they share an interference paradigm with another person. Participants performed the PWI paradigm, which requires to name a picture while ignoring a distractor word, both individually (baseline) and co-acting with an alleged partner (joint task). Results showed that, compared to the baseline and to a control condition in which participants continued to perform the PWI individually, the belief of co-acting with another individual suppressed the semantic interference effect (i.e., slower naming times for semantically related picture-word pairs) when the co-actor was thought to be in charge of the distractor words but not when s/he was thought to work on the same stimuli (pictures) as the participant. Task sharing was effective in eliminating the semantic interference effect only when written word recognition was made more difficult by presenting distractor words in case alternation letters (mOuSe). These results can be explained by assuming that the information about the co-actor's task in a context of impaired word recognition would provide participants with an effective strategy to ignore the task irrelevant information when another person is in charge of this information.

Semiosis process in the educational joint action

G

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In this proposal, we analyze *educational* joint action, as an institutional and asymmetrical joint action. We show some consequences of these two dimensions on the joint action. In particular, we focus on the semiosis process that enables the teacher and the students to make joint predictions and to draw joint inferences.

We use an ethnographic methodology, while relying on cases studies at primary school.
The first case study refers to a situation in which young students and their teacher have to build together means of remembering a collection of objects, on a long duration process, by elaborating shared public representations of these objects.
The second case study aims to explore how visually impaired children and their teacher have to compensate the impossibility of creating shared visual signs, notably by using proxemic techniques. We focus on reading sessions using tactile books.
In both cases, we try to understand how a system of symbolic forms enables the participants in joint action to share a perceptual common background. We study to what extent, and in what ways, the different features of these situations determine the nature of these representational systems and the unfolding of the joint action, in shaping a specific though style.

Joint action changes attitudes towards the self and others

2

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Social interaction with a member of a certain group can alter implicit attitudes about the entire group. In the present study we tested if joint action also affects a person's implicit attitudes towards the self and others. We developed a social version of the Go/No-go association task (GNAT; Nosek & Banaji, 2001) to assess implicit attitudes in a joint setting and an individual setting. In Experiment 1, we found more pronounced implicit attitudes towards the self and others in the joint setting compared to the individual setting. To control whether this finding might be due to a general change in information processing when interacting with others, we tested in a second experiment if joint action changes participants' attitudes towards other categories (fruits and insects). Implicit attitudes for fruits and insects were of comparable size in the joint and the individual setting. Our results suggest that joint action affects the way we think about ourselves and others, while it does not influence our attitudes towards other (less social) categories (fruits and insects). The representations coding personal social attitudes seem to be highly flexible and susceptible to modulations of the social context.

Dyadic cooperation enhances retrieval and recall of crossword solutions

I

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The benefits of collaborative activities have been demonstrated in many domains, but there remain mixed results across several others as to whether collaborative groups can achieve greater performance than individuals, and can achieve greater performance than nominal group comparisons. Here we develop a task that is especially suited to testing collaborative gains on a memory and decision-making task. In a collaborative crossword game, two individuals either solved puzzle questions alone or collaboratively through discussion. When talking, participants solved more puzzle questions, solved them more quickly and accurately, and in general seemed to recall the words from collaborative contexts better than from matched independent contexts. By extracting the audio of their interaction, we also demonstrate interesting relationships between spoken interaction and performance on the collaborative tasks. This task environment further substantiates the notion that, in the context of knowledge retrieval, two heads are better than one.

Between languaging and languagers: Rethinking knowledge of language

J

Georg Theiner

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The "distributed language movement" (DLM) has emerged as a new kid on the block in contemporary debates over the nature of language, and how it ought to be studied (Cowley 2007, 2009a; 2009a; 2011a). Combining the framework of distributed cognition (Hutchins 1995) with ideas from integrational linguistics (Harris 1981), dialogism (Linell 2009), ecological psychology (Gibson 1979), and embodied neuroscience (Damasio 1994), DLM conceives of language as an ecological, dialogical, sense-saturated, and non-local activity centered on achieving the inter-personal coordination of wordings. The radical rhetoric and theoretical orientation of DLM is diametrically opposed to the classical "internalist" view of language as an internalized computational system (Chomsky 1986). However, it is fair to say that orthodox fundamentalist versions of this internalist view no longer dominate the mainstream of linguistics and cognitive science. Rather than implausibly pitting "internalist" against "distributed" accounts of language, and thus to perpetuate what may well be a false dilemma, I distinguish six theses that are frequently run together in the literature on DLM:

the psychological reality of mental representations ("representation thesis"); the purely symbolic, amodal nature of mental representations ("modality thesis"); the autonomy of linguistic vis-à-vis non-linguistic activities ("autonomy thesis"); the ways in which linguistic meanings are partly constituted by the natural, social, or temporal environment in which linguistic interactions take place ("semantic externalism"); the ways in which linguistic processes are bodily, socially, or culturally distributed ("process externalism") the emergent collective reality of linguistic structures ("linguistic collectivism")

By examining each of these six theses individually, I aim to show that DLM should not be understood as a "package deal" utterly incompatible with internalism. A more eclectic mix between internalist and distributed approaches is better apt to unravel the complex webs of linguistic scaffolding that we spin around us, but that also spin us.

Joint action and creativity: Collective implementation intentions improve idea generation performance

2

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Joint action is possible when humans coordinate their behavior. This coordination represents an obstacle when a task requires divergence, such as creativity. Pre-planning when, where, and how to act with *implementation intentions* (Gollwitzer, 1999) has been shown to stabilize individual goal striving against similar obstacles and the present research asks whether pre-planning collectively with *collective implementation intentions* (cII) supports creative joint action. Participants interacted with alleged other group members and then took part in a creativity test, allegedly to determine whether the group would perform a less creative (and boring) or a more creative (and interesting) future task. Actually, participants performed this creativity test fully independently. All participants formed the goal to perform well and either added if-then implementation intentions or control plans which either referred to the individual or the group (collective). It was expected and found that collective goals without implementation intentions lead to fewer generated ideas than individual goals and plans. However, participants with collective goals and if-then plans referring to the group (cII) created as many ideas from as many different categories as participants with individual goals and plans. If-then planning can thus help overcome the boundaries of joint action. Theoretical implications are discussed.

Speech and movement constraints on interpersonal coordination and communication

F

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There is a growing understanding that movement plays a key role in cognition. Spontaneous coordination of movement also occurs between individuals verbally interacting while solving a task together. The goal of the present research was to evaluate whether the movement coordination observed during conversation may embody the cognitive coordination required for effective communication by investigating the influence of verbal and movement constraints on coordination and communication. Individuals took part in a cooperative find-the-differences task while we manipulated degree of constraint on movement (gesturing was restricted) or speech (key "taboo" words were restricted from use). Coordination was negatively affected by an asymmetric movement constraint within pairs. Although communication was not affected by movement constraint in terms of task performance, speech was significantly correlated with degree of movement, suggesting that constraining movement constrained speech. We also found that verbal constraint decreased coordination and yielded poorer performance in the taboo conditions, showing a link between verbal constraint, coordination, and communication. In summary, lower level constraints (gesturing) influenced coordination and speech, but had no significant influence on performance, but constraining higher level (linguistic) systems affected both coordination and performance. The results will be discussed in terms of embodiment and the interactive alignment model.

Representing shared action outcomes: How novices learn to perform piano duets

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Duet music performance is a paradigmatic example of joint action in which one's own and a task partner's actions combine to create a shared musical outcome. But what is represented in such a joint action? In a recent study, we tested the hypothesis that people learning a new joint action form stronger representations of the shared action outcome than of their own individual contribution. Novices who had never played the piano before learned to perform short duets together with an experienced pianist. After training to play at their maximum speed, we modulated the musical outcome such that participants either heard only the result of their own playing (individual action outcome) or the complete duet music (shared action outcome). An analysis of their performance errors indicated that novices learned the shared musical outcome rather than the outcome of their own individual playing. This provides evidence that, after only short exposure with a new joint action, joint goal representations can be stronger than representations of individual action outcomes.

Mechanisms of intentional coordination: From minimal to information-rich contexts

E

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An increasing amount of empirical evidence suggests that different mechanisms and processes underlie (intentional) coordination of joint actions. These include monitoring and predicting own and others' actions, representing own and others' tasks, strategically adapting one's own actions as well as the dynamic coupling of two or more people's movements. But what determines which mechanism or process predominantly underlies a given coordinated action? I will discuss the possibility that the employment of coordination mechanisms and processes depends on the availability of information about a task partner. When only little is known or only minimal perceptual information is available more general mechanisms will support coordination. With perceptual information about a co-actor's action monitoring and behavioral coupling become possible. And having knowledge about aspects of another's task will help to represent and form predictions about this person's actions. I will discuss empirical evidence for this idea of a dimension of information availability that determines which mechanism or process will be predominantly employed to achieve coordination with others.

Who carries your past? How social contexts and remembered actions influence perceived distance

1

David W. Vinson and J. Scott Jordan

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It is known that specific perceptual variables such as perceived distance to an object are subject to influence specifically by physical burdens (Proffitt et al. 2006) and one's action abilities (Witt, 2011). Perceptual variables such as perceived distance contain information about the relative costs of planned future action. This is consistent with the finding that cortical areas involved in perception are also involved in the production of motor action. The present experiments aimed to address if the observation of another's motor action influences perceptions of distance. Participants estimated distance in two phases, 1) while under the constraint of carrying or not carrying a weighted backpack and then 2) carrying or not carrying a weighted backpack while following another carrying or not carrying a weighted backpack. Perceived distance was greatest in the no backpack condition when following another carrying a backpack only after having previously carried a backpack. That is, one's social context influences the perception of planned future action through the activation of one's remembered motor actions. This supports the notion that the perception of future goals is influenced by current motor action constraints and also the constraints of one's social context when it carries information about previous motor action.

Within- and between-person integration of spatial visual information

2

Pavel Voinov, Günther Knoblich and Natalie Sebanz

Central European University, Hungary

Previous research has demonstrated that people cannot only efficiently integrate different sources of sensory information within their own cognitive system (Ernst and Banks, 2002) but that they can also integrate their own and others' meta-cognitive judgments using verbal communication (Bahrami et al., 2010). In the present study we directly compared within and between person integration of visual information. Participants were asked to locate objects in 2D projections of 3D objects. We generated projections from different camera angles to simulate different perspectives on the same layout. Participants performed the location task in three conditions: (1) alone from one perspective; (2) alone from two perspectives; (3) with a partner, who had a different perspective. Participants' location accuracy was significantly higher in conditions (2) and (3) as compared to condition (1). Also, there was no difference between condition (2) and (3). The results provide first evidence that perceptual integration across individuals may be as efficient as perceptual integration within individuals.

Take my hand: The temporal and spatial coordination of handshaking

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Handshakes play an important role in joint social actions. They often bookend the start and end of a social interaction, set the tone for how one is perceived (Bernieri & Petty, 2011) and can determine one's future earning potential (Stewart et al., 2008). While past work has focused on the subjective quality of a handshake, the present investigation examines the dynamics and coordination of various nonverbal cues that are critical to shaking hands successfully. Experiment 1 filmed and analysed 177 students as they shook hands with a university chancellor during graduation. The timing and coordination of specific bodily actions -- gaze direction and hand extension -- were suggested to be critical to the remarkable stability we observed between the time the chancellor extended her hand to the time hand contact was made. Experiment 2 tested and confirmed this hypothesis. We demonstrated that a subtle and powerful temporal and spatial relationship between gaze direction and hand extension is crucial to a successful handshake and appears to aid in disambiguating handshakes from other possible actions. For instance, if hand extension precedes joint gaze, then the hand can be interpreted as a directional cue rather than an offer to shake hands.

Aperiodic interpersonal coordination: The power of feedback delay

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One only has to consider the performance of a group of improvisational jazz musicians to be reminded that people are capable of coordinating in an effortless manner, even when faced with highly variable, often unpredictable behavioral events. While a substantial amount of research on joint-action has focused on the coordination that occurs between simple stereotyped or periodic movements, a larger proportion of everyday social and interpersonal interaction requires that individuals coordinate complex, aperiodic actions. In fact, many of the actions performed by individuals in an interactive context likely exhibit characteristics synonymous with chaos (i.e., are unpredictable yet deterministic). Although counterintuitive, recent research in physics and human movement science indicates that small temporal feedback delays may actually enhance an individual's ability to synchronize with chaotic environmental events. Together, this research suggests that a similar process may be at work in the interpersonal coordination of aperiodic behaviors. Here we present data from a study that investigated this possibility. The results suggest that individuals are able to coordinate with the aperiodic (chaotic-type) movements of other individuals and that small information feedback delays may (in some instances) enhance such joint-action coordination and facilitate social anticipation.

Collaborative cognition in sports teams

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Team sports are fundamentally collaborative activities. They demand that multiple people act together skillfully, coordinating their actions and making decisions in the face of a changing task environment. In the context of severe temporal, perceptual and emotional pressures, teams decide and act quickly and flexibly, often without prior deliberation or explicit communication. This paper is primarily theoretical, aiming to expand existing theories of group and dyad behavior to sports teams. We draw on Wegner's transactive memory theory (1986) and shared mental model theory (Eccles & Tenenbaum 2004; Eccles & Johnson 2009) to explore theoretically the ways in which team members' shared memory and knowledge of task-relevant and team-relevant information assists the team in coordinating their actions. To support this theoretical work we conducted semi- structured interviews with members of Oz-Tag and Touch Football teams. Players were interviewed separately while watching footage of key moments from a single game. Their responses were coded to identify similarities and differences in knowledge of relevant information. We found that player's with a longer history of playing the relevant sport and doing so together had a more detailed knowledge of the team's processes. Both the theoretical and empirical aspects of this paper highlight the roles that shared history, shared knowledge and shared semantic memory play in shaping a teams' co-ordination. References

Investigating the behavior of children and chimpanzees in coordination problems

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The traditional paradigm for investigating human cooperation has been the 'social dilemma'. This is a game theoretic model that examines how collective action can stablize, when threatened by the profitability of individuals' selfish actions (e.g. Bowles and Gintis, 2011; Boyd and Richerson, 2008). However, another model known as a 'coordination problem' (see, e.g., Schelling, 1960; Skyrms, 2004) re-focuses the challenge of cooperation to ask: How can collective action emerge when it is advantageous to all, but requires the complex coordination of actions and intentions towards some cooperative outcome?

A series of studies will be summarized that investigate the behavior of both young children and our closest living relatives, chimpanzees, in coordination problems. The main results will suggest that, under conditions in which individuals can easily monitor each other, coordination rates and strategies between the two species appear similar. Under more challenging conditions, however, they begin to differ with respect to the stability of their cooperative actions, and especially the role of communication in supporting them. The specific mechanisms by which child peers converge on cooperative solutions will then be explored in more detail. Lastly, the implications of these findings for the evolution of cooperation in humans will be discussed.

Difference in single vs. pair judgements on deception detection, confidence and bias based on the level of communication

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When people judge whether others are telling the truth, they act differently if they are working alone or in a group. The current experiment explored this finding by varying the amount of information that participants (working alone or in a pair) could communicate while making veracity decisions. The information that participants provided varied on three levels: a binary truth/lie decision, a binary decision and a set of reasons chosen from a list, or an open ended discussion/ explanation. Being alone or in a pair had no significant effect on accuracy, but confidence was higher in the pair condition. A truth bias was found in the single condition but was mostly eliminated for pairs. As was predicted, the amount of information provided after each decision had an effect on accuracy, bias, and confidence. Lie detection accuracy was highest when stating a reason chosen from a list, while confidence increased with the amount of information provided. In pairs, specifying a reason or conversing while making the veracity decision eliminated the truth bias. The current findings improve our understanding of the effect of pair decision making, illustrating how varying levels of information can have different effect on decision making and deception detection.