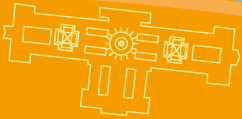




# BCCCD 2017

Budapest CEU Conference on Cognitive Development

## Program



# **BCCCD 2017**

Budapest CEU Conference  
on Cognitive Development

**ORGANIZED BY**

Cognitive Development Center  
Central European University

[cognitivescience.ceu.hu](http://cognitivescience.ceu.hu)  
[assisztencia.hu/bcccd](http://assisztencia.hu/bcccd)  
5-7 January, 2017  
Budapest, Hungary



## **CONFERENCE ORGANIZATION**

The conference is organized by the Cognitive Development Center at CEU  
Cognitive Science Department, led by Professors Gergely Csibra and György Gergely

## **CONFERENCE CHAIRS**

Gabor Brody  
Frances Buttelmann

## **SCIENTIFIC COMMITTEE**

Current members of the Cognitive Development Center at CEU

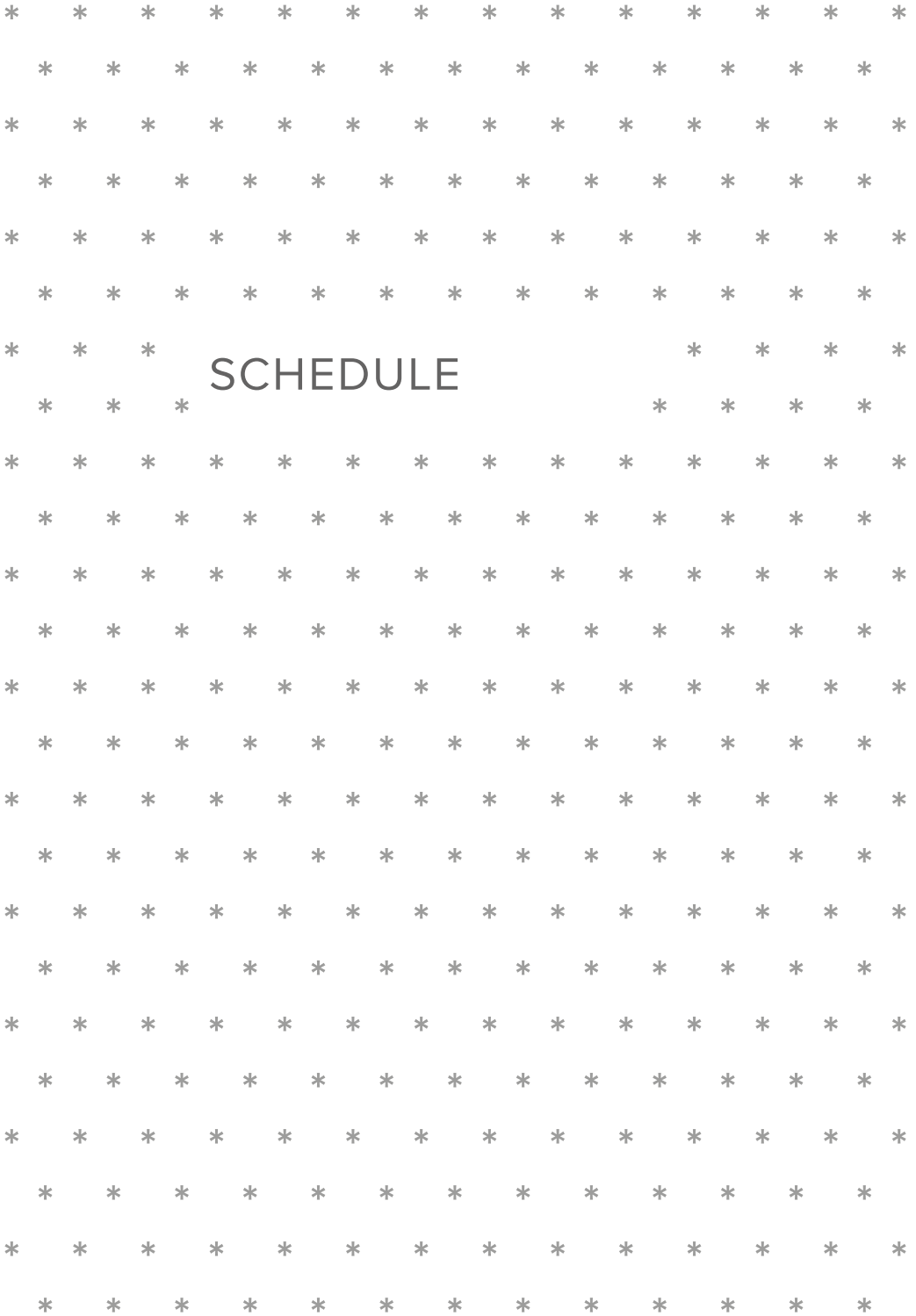
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# SCHEDULE

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**January 4, Wednesday**


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**16:00 - 20:00**                    **PRE-REGISTRATION**


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**January 5, Thursday**


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**08:00 - 19:00**                    **REGISTRATION**
**BCCCD16 PRE-CONFERENCE SESSIONS**
**08:45 - 10:15**                    **TOBII WORKSHOP 1.**
**10:15 - 10:30**                    **COFFEE BREAK**
**10:30 - 12:00**                    **TOBII WORKSHOP 2.**
**12:00 - 13:00**                    **LUNCH**
**BUDAPEST CEU CONFERENCE ON COGNITIVE DEVELOPMENT 2017**
**13:00 - 13:15**                    **BCCCD17 WELCOME**
**13:15 - 15:15**                    **REGULAR SYMPOSIUM**

 The influence of group membership on learning  
and reasoning in young children

**15:15 - 17:15**                    **POSTER SESSION A** (with coffee & snacks)

**17:15 - 18:45**                    **PAPER SESSION 1.** Learning and reasoning

**18:45 - 20:00**                    **INVITED LECTURE 1.**

 The neuroscience of social emotions and cognition:  
From ontogeny to plasticity

**20:30 - 22:00**                    **WELCOME RECEPTION**

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**January 6, Friday**


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<b>8:00 - 18:00</b>	<b>REGISTRATION</b>
<b>8:30 - 10:00</b>	<b>PAPER SESSION 2.</b> Social interactions
<b>10:00 - 10:30</b>	<b>COFFEE BREAK</b>
<b>10:30 - 12:00</b>	<b>PAPER SESSION 3.</b> Cueing
<b>12:00 - 13:00</b>	<b>LUNCH</b>
<b>13:00 - 15:00</b>	<b>INVITED SYMPOSIUM</b> Representing abstract knowledge
<b>15:00 - 17:00</b>	<b>POSTER SESSION B</b> (with coffee & snacks)
<b>17:00 - 18:30</b>	<b>PAPER SESSION 4.</b> Word learning

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**January 7, Saturday**


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<b>8:00 - 18:00</b>	<b>REGISTRATION</b>
<b>8:45 - 10:00</b>	<b>INVITED LECTURE 2.</b> When and why children are better learners than adults
<b>10:00 - 10:30</b>	<b>COFFEE BREAK</b>
<b>10:30 - 12:30</b>	<b>PAPER SESSION 5.</b> Theory of mind
<b>12:30 - 13:30</b>	<b>LUNCH</b>
<b>13:30 - 15:00</b>	<b>PAPER SESSION 3.</b> Numbers
<b>15:00 - 17:00</b>	<b>POSTER SESSION C</b> (with coffee & snacks)
<b>17:00 - 19:00</b>	<b>PAPER SESSION 7.</b> Resource allocation and justice
<b>20:00</b>	<b>CONFERENCE DINNER</b>



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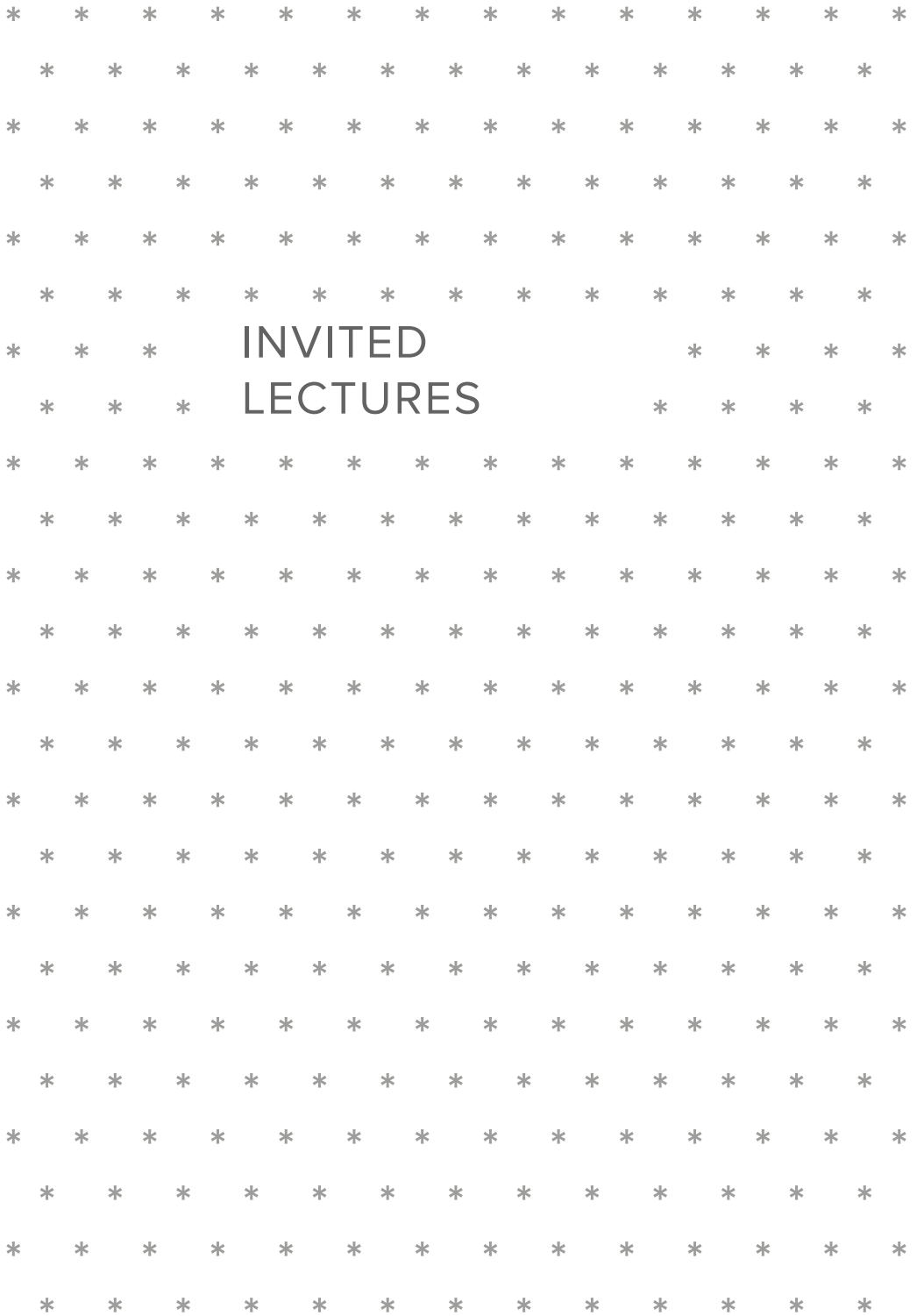
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INVITED  
LECTURES

**IL1**

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**Tania Singer**

Department of Social Neuroscience at the Max-Planck-Institutue, Leipzig, Germany

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## **The Neuroscience of Social Emotions and Cognition: From Ontogeny to Plasticity**

The social neurosciences have focused on the question of how people relate to and understand each other. Hereby, researchers have distinguished between at least two different routes on the understanding of others: one affective-motivational route referring to our ability to feel with (empathy) and for (compassion) another person, and a cognitive route allowing to infer other people's intentions, believes, and thoughts - a capacity also referred to as Theory of Mind, mentalizing or cognitive perspective taking. While it has been proposed that humans share states of others by means of projecting their own mental or feeling states onto the other, such a mechanism also has the risk of resulting in an emotional egocentricity bias (EEB), especially in situations when others feel or think differently than oneself.

After introducing relevant concepts and their underlying neuronal basis, I will present newly developed paradigms and results regarding the development of social emotions and EEB in children and suggest that it is the late development of parietal-frontal networks that predict increased emotional egocentricity in younger children. More specifically, I will argue that overcoming emotional egocentricity relies on socio-affective brain networks including the supramarginal gyrus, whereas inhibiting incongruent cognitive beliefs engages adjacent brain structures related to the mentalizing network including the temporo-parietal junction. I will further present results from studies revealing evidence for a similar dissociation in autism as well as through the differential training of socio-affective and socio-cognitive capacities in healthy adult populations. More specifically, I will introduce the ReSource Project, a large-scale multi-methodological one-year secular mental training program that aimed by means of three distinct 3-months training modules at the cultivation of 1) attention and interoceptive awareness, 2) meta-cognition and perspective taking on self and others, and 3) empathy, compassion and prosocial motivation in more than 200 subjects. I will present first training-module specific findings suggesting malleability of the social brain on the level of behavior, brain, and health and discuss their relevance for models

**IL2**

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**Alison Gopnik**

University of California at Berkeley, Berkeley, CA

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**When children are better (or, at least, more open-minded) theorists than adults: Theory formation, causal models, and the evolution of learning**

In the past 15 years we've discovered that even young children are adept at inferring causal structure from statistical patterns. But can they also learn more abstract theoretical principles? And are there differences in the ways that younger children, older children and adults learn? I will present several studies showing that preschoolers can learn abstract higher-order principles from data, as well as studies of adolescents, low SES American children, and Peruvian children on the same tasks. In each case, younger learners were actually better at inferring unusual or unlikely principles than older learners. I relate this to computational ideas about search and sampling, to evolutionary ideas about human life history, and to neuroscience findings about the negative effects of frontal control on wide exploration, and the advantages of earlier neural architectures for wide-ranging learning. Our hypothesis is that childhood is evolution's way of performing simulated annealing. Our distinctively long human childhood allows a period of broad "high-temperature" hypothesis search.





INVITED  
SYMPOSIUM

**IS**

**REPRESENTING ABSTRACT KNOWLEDGE**

**Discuccant:**

Susan Carey, Department of Psychology, Harvard University, Cambridge

**Speakers:**

Ghislaine Dehaene-Lambertz, INSERM U992, Neurospin, Saclay, France

David Barner, Language and Development Lab, UC San Diego, USA

Martin Giufa, Research Centre on Animal Cognition, Center of Integrative Biology, University of Toulouse, CNRS, Toulouse, France

**IS-01**

**Are human infants able to use symbols?**

Ghislaine Dehaene-Lambertz

INSERM U992, Neurospin, Saclay, France

Human adults commonly use symbolic systems (e.g. speech, numbers, writing code, algebraic formula) to represent aspects of the external world, and they easily and flexibly go from symbols to objects and vice-versa. This “symbolic mind” might be related to a distinct human neural architecture, in particular, the expansion of the associative areas and the development of new long-distance fiber tracts, such as the arcuate fasciculus. More efficient connections to and from the frontal lobe and a longer memory buffer may lead to the discovery of more abstract structures, and ultimately enable to represent the external world with a symbolic system.

This neural architecture is in place at full-term birth and brain imaging studies have revealed that higher-level associative regions, such as frontal areas, are involved in infant’s cognition from start. We may thus expect that infants might share the same symbolic competence than adults and that they can easily learn labels to represent classes of objects. To support this claim, I will present brain imaging data showing the infants’ structural and functional brain architecture and ERP data obtained through a new paradigm as a first step to test symbolic representations in the infant brain.

**IS-02**

**Access to alternatives and abstract thought**

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**David Barner**

Language and Development Lab, UC San Diego, USA

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Word learning often takes the form of abductive inference, whereby a learner makes a "best guess" regarding the intentions of a speaker on the basis of sparse evidence. In this sense, word learning is a special case of pragmatic reasoning as it occurs in typical, adult, conversation, requiring listeners to go beyond what is literally said to infer speaker meaning. In this talk I describe how children exploit structured alternatives to restrict conversational inference and word learning, to acquire abstract concepts of color, time, and number.

**IS-03**

# **Abstract Knowledge in an Insect Brain**

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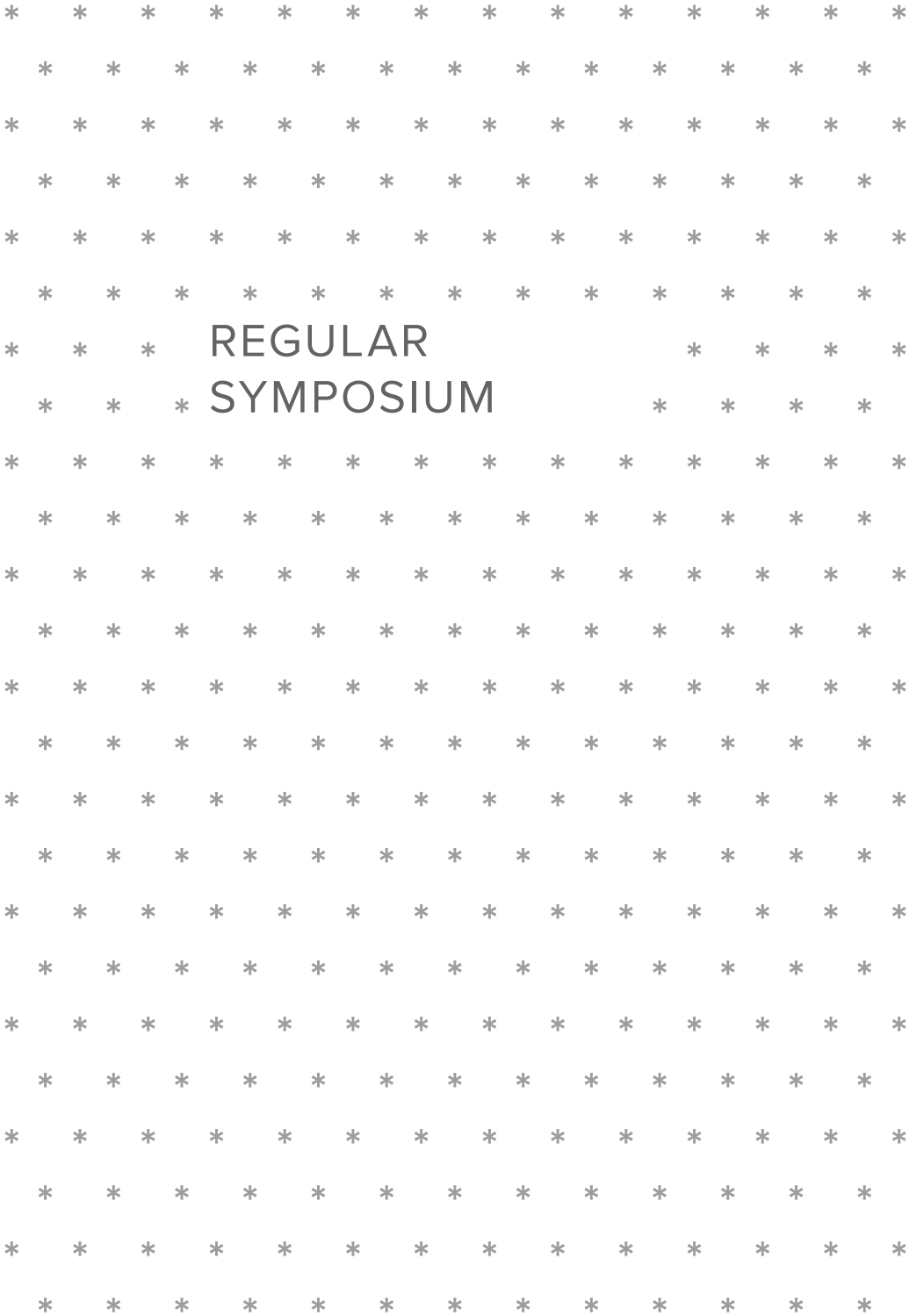
**Martin Giurfa**

Research Centre on Animal Cognition, Center of Integrative Biology, University of Toulouse, CNRS, Toulouse, France

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Honey bees display a rich and interesting behavioral repertoire, in which learning and memory play a fundamental role. Besides elemental forms of learning, in which bees learn specific and univocal links between events in their environment, bees also master different forms of non-elemental learning both in the visual and in the olfactory domain. Cognitive feats include different forms of categorization and concept learning. Here we will review experimental evidence for relational rule learning in bees, and provide evidence for the extraction of relationships such as ‘same as’, ‘different of’, ‘above/below of’, ‘on the left/right of’, among others. We will show that these insects not only extract these relations between objects in the environment but, more importantly, that they transfer this knowledge to unknown objects preserving the learned relation, even if they differ dramatically from learned ones. We will also show that, besides identity matching to sample, bees may also pay attention to the fact that distinct objects presented simultaneously may be linked by a specific internal relation, thus supporting a capacity to perform relational matching to sample.

The fact that this kind of problem solving is mastered by bees may create the idea that relational learning does not represent a higher-order form of mental representation. Yet, this conclusion has some caveats: should we claim that concepts are lower-form representations just because bees possess them? Although it is sometimes assumed that miniature nervous systems like those of insects implement cognitive faculties by radically different mechanisms compared to vertebrates, constructing a great division between “simple” and “advanced” nervous systems may lead us astray because the basic logical structure of the processes underlying spontaneity, decision making, planning and communication are similar in many respects in big and small brains.



REGULAR  
SYMPOSIUM

**RS**

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## **THE INFLUENCE OF GROUP MEMBERSHIP ON LEARNING AND REASONING IN INFANTS AND CHILDREN**

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**Organizer:**

**Rana Esseily**, Laboratoire Ethologie, Cognition, Développement, University of Nanterre, France

**Speakers:**

**Hanna Marno**, Department of Cognitive Science, Central European University,  
Budapest, Hungary

**Kata Oláh**, Institute of Psychology, Eötvös Loránd University; Institute of Cognitive Neuroscience and Psychology,  
Hungarian Academy of Sciences, Budapest, Hungary

**Rana Esseily**, Laboratoire Ethologie, Cognition, Développement, University of Nanterre, France

**David Buttelmann**, Department of Psychology, University of Bern, Bern, Switzerland

For efficient interactions, humans need to form cognitive representations of social partners and of human groups in general. There is a growing body of literature on how infants and children process interactive situations and the cues that orient their social preferences and behaviors. A counterpart's gender, race, ethnicity and language are well documented cues that already infants use for social categorization and by doing so they show a strong bias to interact with members of their own group. However, the functions of this bias are still unclear. The current symposium proposes that these cues help infants to detect members of their community, which are interaction partners with whom they share the same knowledge and who are possible sources of information helping infants to become members of their cultural society. Thus, it is important for learners to be able to orient their attention towards and focus on in-group members, to track their mental states such as their beliefs and to be able to interact and communicate with them in a variety of situations. Papers 1 and 2 aim at showing that group membership (experienced by observing an adult performing conventional tool use or speaking the same language) helps infants to pay specific attention to the information presented by the in-group informant. For example, 3-year-old children prefer to imitate and learn from those who show evidence of being knowledgeable in the ways of their cultural group's conventional use of tools. This demonstrates that the categorization bias induced by individual characteristics is in fact a cue that orients social learning towards possible sources of information. Paper 3 shows that this categorization bias also guides preschoolers' prosocial behavior as 5- and 6-year-olds were slower to

cooperate with a foreign speaker compared to a native. Paper 4 shows that at around the same age, this in-group bias makes children either generalize their own knowledge to in-group member or makes them neglect the beliefs of in-group members if irrelevant for solving the task. In contrast, in the very same task, they automatically track the beliefs of out-group members. In conclusion, the four papers of this symposium clearly show that an interaction partner's group membership is not a mere question of preference or familiarity. Instead, it is an important cue that gains importance within a process of enculturation, in which children seek to acquire the practices of their own cultural environment and to track the mental states of possible opponents.

**RS-01**

# **The role of language in social cognition: Beyond the social groupism effect**

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Hanna Marno<sup>1</sup>, Bahia Guellai<sup>2</sup>, Yamil Vidal<sup>3</sup>, Julia Franzoi<sup>3</sup>, Marina Nespør<sup>3</sup>, Jacques Mehler<sup>3</sup>

<sup>1</sup>Department of Cognitive Science, Central European University, Budapest, Hungary

<sup>2</sup>Laboratoire Ethologie, Cognition, Développement, University of Nanterre - France

<sup>3</sup>International School for Advanced Studies, Trieste, Italy

---

In the past many studies investigated infants' preference for speakers of their native language (e.g. Mehler et al., 1988; Kinzler et al., 2007). According to many researchers, this preference for native speakers is the basis of dividing the world into social groups and establishing ingroup-outgroup dispositions (Kinzler, 2007). However, we propose that infants prefer native speakers also because they can acquire culturally relevant knowledge from them. Thus, we predict that when infants are exposed to some new information, presented by either a native or a foreign speaker, they will pay more attention to the information provided by a speaker of their language. In our experiment 12-month-old monolingual Italian infants were first familiarized with two speakers, one of them talking in Italian and the other talking in Slovenian to them. After, in the Teaching Phase each of the two speakers silently gazed towards two unfamiliar objects. At the Test Phase infants saw only the objects in pair. Results revealed that they preferred to look at the object that was presented by the Italian speaker, compared to the object that was presented by the Slovenian speaker. Recent results with 5-month-old infants indicate that this effect is also present at much younger age. These findings provide evidence that infants tend to pay more attention to the information presented by a person with whom they share the same language. We believe that this selectivity can serve as a basis for establishing social learning processes by influencing infants' choices between potential sources of information.



**RS-02**

**Preschoolers learn selectively from culturally knowledgeable individuals**

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Kata Oláh<sup>1,2</sup>, Ildiko Király<sup>1,3</sup>

University of St Andrews, UK

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One of the potential benefits of representing social categories for children is that it helps them identify culturally competent individuals who may provide information that is useful in their social environment. Our aim is to investigate the role of shared cultural knowledge in children’s selective learning processes. In the first study, 3-year-old children were presented with videos of two models performing simple tool using actions. One of the models performed the actions in the manner that children are accustomed to while the other one violated the cultural norm. In the test phase, children watched both models demonstrate a target action with one step performed differently by the two models. Children were then allowed to reproduce the actions and choose the variant they preferred. We found that the majority imitated the step that was introduced by the conventional tool user. In the second study, we tested whether 4-year-old children understand the cultural aspect of tool functions and thus we hypothesized they would selectively assign a specific function to a new tool only when the function is demonstrated by an in-group model. Preliminary results seem to confirm this hypothesis. These results suggest that children are sensitive to the boundaries of shared knowledge and prefer to learn from those who show evidence of being knowledgeable in the ways of their culture.

**RS-03**

# **The effect of language on prosocial behaviors in preschool children**

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Rana Esseily<sup>1</sup>, Eszter Somogyi<sup>2</sup>, Eszter Somogyi<sup>1</sup>

<sup>1</sup>Laboratoire Ethologie, Cognition, Développement, University of Nanterre, France

<sup>2</sup>Laboratoire Psychologie de la perception, University of Paris Descartes, France

---

Language is one of the most important cues to group membership, helping infants to detect with whom they share the same knowledge, culture and norms. Still, we do not know much about how language guides prosocial behavior and how children select among possible social partners in helping and cooperative situations on the basis of the language the partners speak. Indeed, although in toddlers' spontaneous helping behavior seems to be intrinsically motivated, older children show more selectivity when it comes to acting prosocially. We explored how language guides this selectivity by proposing different cooperative tasks (e.g. picking up a dropped clothespin, approaching an out-of-reach button or holding a container at the end of a tube in order to receive a ball) to French and Hungarian preschoolers between 3 and 6 years of age, with a partner who spoke either their own language or a different one. We found that language had an effect on preschoolers' cooperative behaviors, especially between 5 and 6 years of age. Thus, 5- and 6-year-olds were slower to cooperate with a foreign speaker compared to a native one than younger children. They also needed more solicitations from the foreign speaker prior to the task than the younger ones before cooperating. We conclude that from 5 years of age, children not only start to form robust in-versus out-group categorizations according to the language spoken by their potential social partners, but also orient their cooperative behaviors accordingly, cooperating more readily with partners who share the same language.

**RS-04**

# **Children’s affiliation with bystander agents affects automatic belief attribution**

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David Buttelmann <sup>1</sup>, Frances Buttelmann <sup>2</sup>

<sup>1</sup>Department of Psychology, University of Bern, Bern, Switzerland

<sup>2</sup>Cognition & Development Lab, University of Frankfurt, Frankfurt, Germany

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Representing one’s own thoughts as well those of others is relevant for successful interaction with others. Thus, the question arises as to how social factors influence the attribution of mental states to other people. A factor that plays a specific role in the evaluation of other people in interaction and communication is affiliation. While we rate affiliated people more positively in terms of popularity and intelligence and elect them as reliable models more frequently, adults and children seem to overgeneralize their own perception and knowledge to their communication partner when communicating with friends. The communication with strangers, on the other hand, seems to stimulate exchange of perspectives. The current study investigated how children’s affiliation to bystander agents affected their automatic attribution of beliefs to those bystander agents. Five- to 6-year-olds played a video game in which their task was to put an animal (e.g. a cat) into one of three boxes by avoiding the one box containing an angry animal (e.g., a dog). We manipulated a bystander agent’s beliefs about the location of the angry animal. Thus, the bystander agent’s beliefs were irrelevant for children’s success in the task. We further manipulated children’s level of affiliation with this bystander agent. Preliminary results (n=33) suggest that children attribute beliefs to the bystander agents, and those beliefs affect children’s decisions. Supplementary analyses propose that children did so specifically for non-affiliated bystander agents. Thus, the influence of affiliation, demonstrated in other domains of cognition, is present also in the automatic attribution of beliefs.



**PS1-01**

**Preschoolers adapt their explorative actions to the information structure of the task**

Azzurra Ruggeri <sup>1,2</sup>, Zi Lin Sim <sup>2</sup>, Alison Gopnik <sup>2</sup>

<sup>1</sup> Max Planck Institute for Human Development, Berlin, Germany

<sup>2</sup> University of California, Berkeley

In this paper, we investigate whether 3- to 5-year-olds (N=88) are sensitive and adapt their exploratory actions to different information structure (i.e., distribution of likelihood across different hypotheses) of the environment.

**Training.** Participants are presented with two big boxes, each containing two smaller boxes. The experimenter places an egg shaker in one of the small boxes, four times. In the uniform condition the experimenter always places the egg in a different small box; in the skewed condition she always places the egg in the same small box. After each placement, children are asked to retrieve the egg and use it to activate a light-up toy. Children are then demonstrated two actions that are useful to find out whether a big box contains the egg: Shake it (the egg would sound if in one of the two small boxes contained), or open it, together with at least one of the small boxes inside.

**Test.** The experimenter hides the egg in one of the small boxes. The child is asked to find it, and is told that he can open only one of the big boxes.

Three- and 4-year-olds (70%) in the skewed condition opened the big box containing the small box where the egg had always been placed during training. In the uniform condition the majority of them (65%) shook the boxes first, to find out which one to open. On the contrary, most 5-year-olds (85%) shook the box first, in both conditions. We discuss alternative interpretations of these developmental differences.

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**PS1-02**

**Explaining away: how great apes learn causal structures by discounting alternatives**

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Under natural conditions, animals often face situations with multiple events covarying in space and time. This poses a problem for causal learning because the causal structure underlying these events remains ambiguous. Here, we address the question how nonhuman great apes reduce this ambiguity based on (1) the temporal structure of events and (2)

observed interventions. First, we presented apes with a task in which they needed to locate invisibly displaced food rewards based on visual trails. Crucially, apes distinguished trails based on the temporal order of cause and effect by ignoring trails that were already present before the reward was hidden. Control conditions ruled out that features of the trail itself led them to the baited container or that apes generally preferred the most recent trail they encountered. Second, we adapted the blinket detector paradigm for apes. Apes and 2.5-year-old children spontaneously distinguished between confounded and unconfounded interventions and preferred objects whose effect on the apparatus was unconditional of other objects. Together, these studies suggest that apes, like human children, use temporal structure and (observed) interventions to elucidate causal structures.

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**PS1-03**

**Teleology-in-Perspective: The role of counterfactual reasoning in false belief reasoning**

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Accumulating evidence suggests that counterfactual reasoning is involved in false belief reasoning. But traditional false belief tasks and simple counterfactual reasoning tasks (e.g., Harris, German, and Mills 1996, *Cognition* 61) only allow one kind of error: the Reality Error. Recent findings in counterfactual reasoning tasks identified a second possible error and found that children do not avoid this error before age 6 (Rafetseder, Christi-Vargas, and Perner 2010, *Child Development* 81). We call this the Basic Conditional Reasoning (BCR) error. We developed a false belief task that enabled the BCR error, and investigated the relationship between false belief reasoning and counterfactual reasoning using these more subtle tests. 171 children, adolescents and adults participated in two experiments. Both experiments found high correlations ( $r = .58$  and  $r = .73$ ) between counterfactual and false belief questions. We conclude that counterfactual reasoning has a role in false belief reasoning, but we distinguish two strategies for reasoning with counterfactual assumptions. One—Basic Conditional Reasoning—leads to success on simple counterfactual and false belief tasks, but yields BCR errors on both of our more subtle tasks. The other strategy yields success on all tasks. This helps explain why children can pass some false belief and counterfactual reasoning tasks when young but continue to fail more complex false belief and counterfactual reasoning tasks for several years. Findings shed light on two recent theories, Adaptive Modelling and Teleology-in-Perspective.



PAPER SESSION 2  
SOCIAL INTERACTIONS

**PS2-01**

**Mighty or the Meek: Changes in Social Preferences Across the First Two Years of Life**

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Every human society includes social hierarchies--relationships between individuals and groups of unequal rank or status. Recent research has shown that even preverbal infants represent hierarchical relationships—expecting that rank between individuals will be stable across situations, and that larger agents and agents from larger groups will win dominance contests (Mascaro & Csibra, 2012; Pun, Birch, & Baron, 2016; Thomsen, Frankenhuis, Ingold-Smith, & Carey, 2011). However, to successfully navigate social hierarchies, humans must also integrate information about social rank into their own behavior, such as when deciding which individuals to approach and which to avoid. Data from three experiments demonstrate that two-year-old children (ages 21-31 months) prefer novel dominant agents to subordinates. In Study 1, using a modified a replicated paradigm (Pun et al., 2016; Thomsen et al., 2011), we found that toddlers prefer the dominant agent in a zero-sum right of way dominance contest (18/22 reached for the dominant puppet  $p<.001$ ). In Study 2 we found that this preference depends on there being a conflict between the puppets, and in Study 3 we found that the preference also depends on whether the dominant agent reaches its goal. Interestingly, when we repeated Study 1 with 10-14 month-olds, we found a preference for the subordinate agent (17/19 infants chose the subordinate puppet  $p<.001$ ). Together, these findings suggest that both infants and toddlers use phylogenetically stable cues to predict the winner of dominance contests, but that toddlers use the cues to approach dominant individuals and infants use this information to avoid them.

**PS2-02**

**Nonverbal Markers of Collaborative Lying in a Dyadic Context**

Hilal Şen, Ceren Bozkurt, Seren Zeynep Vardar, Aylin C. Küntay

Koç University

This study explores nonverbal markers of spontaneous co-lying in dyadic context. Ninety same-sex pairs of 4- to 6-year olds who knew each other (Mage = 64.18 month, SDage = 9.32) were observed in a modified resistance-to-temptation paradigm, where they were prohibited from touching attractive toys. Later, dyads of children were interrogated at the



same time. Several response characteristics of children were coded right after the target question (“Did you touch the forbidden toys when I was not here?”). The findings showed that truth-telling children were almost 3 times faster to respond to the experimenter than lie-tellers. Moreover, the odds of having an overlap with the peer during responding were 2.56 times higher for truth-tellers than lie-tellers. The odds of gesturing during responding and giving nonverbal response were 4.18 and 9.08 times lower for lie-tellers than truth-telling children. While there was no association between being lie- vs. truth-telling and gazing at the experimenter or other places during responding, the odds of looking at the peer during responding were 6.22 times higher for lie-telling children than truth-tellers, and this pattern was specific to the time right after the target question as there was no association between gazing at the peer during the rest of the interrogation phase and being a lie- or truth-teller. These findings indicate that lie-telling children could be distinguished from their truth-telling counterparts from their collaborative behaviors. Particularly, lie-telling children appear to search for communicative cues (late responding and peer gazing) to coordinate joint action in dyadic context.

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**PS2-03**

**Infants' understanding of cooperative vs competitive goal-directed events involving multiple agents**

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There is growing evidence indicating that human infants are able to interpret the actions of intentional causal agents in terms of goal-directedness and rationality as early as 3 months of age (Gergely et al., 1995; Skerry, Carey, & Spelke, 2013). Despite the progress in the field it is not yet known whether infants' early preparedness to represent goal directed actions of individual agents also allows them to teleologically interpret more complex goal-directed events that involve multiple interacting agents who pursue different types of – cooperative vs. competitive – social goals. A further question concerns whether infants' early understanding of cooperative vs. competitive goal-pursuit would support differential expectations about equal vs. unequal division of benefits.

In order to test these questions we used video animations depicting complex chasing events. These events involved three agents: two chasers and one chasee. Two groups (N=24 in each group) of 13-month-old infants were presented with one of two types of interaction patterns between the chasers representing either cooperative or competitive scenarios. In the cooperative condition the chasers' goal-pursuit exhibited cues of coordination and joint efficiency. In the competitive condition chasers engaged in hindering each other during the

goal-pursuit in order to prevent their opponent from attaining the goal first. During the test phase both groups were presented with either of two kinds of outcome displays. Infants saw the chasers achieve their goal - catching the prey - and distribute the reward either equally (e.g. sharing the 'prey' by eating it up together) or unequally (e.g. one of the agents ate the 'prey' alone without sharing with the other).

Infants' looking time pattern changed as a function of the kind of familiarization event they were exposed to. Following the cooperative chase event they looked significantly longer when the outcome was not shared than when it was, while after seeing the competitive chasing event they showed the opposite pattern: they looked longer at the 'sharing' of the outcome.

These findings suggest that infants can categorize interactive goal pursuit in terms of cooperation vs. competition, which differentially modulated their expectations about the type of distribution (equal vs unequal) of the benefits achieved.



PAPER SESSION 3  
CUEING

**PS3-01**

**Contextual cueing effects on visual selective attention in 6- and 10-month-old infants**

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The ability to prioritize attention to relevant spatial locations in complex visual scenes is critical for engaging with a rapidly changing multisensory world. The rich covariational structure that exists between visual objects and their contexts may serve as a useful top-down cue for orienting attention and guiding visual search (e.g., Chun & Jiang, 1998). Although infants have demonstrated sensitivity to covariation in spatial arrays (Fiser & Aslin, 2002; Kirkham, et al., 2007; Bertels, et al., 2016), it is presently unclear whether they can use visual context to facilitate attention orienting and search. In an eye-tracking experiment, we presented 25 6-month-olds (M=6 months, 19.8 days) and 21 10-month-olds (M=10 months, 2.5 days) with visual search displays, in which an engaging target was hidden among multiple distracters. Invariant visual contexts (in this case, the spatial configuration, shape, and color of items in the display) were repeated throughout the experiment and targets appeared in the same location within each configuration, such that the context predicted the target's location. Both 6- and 10-month-olds successfully distinguished between invariant and variable contexts, exhibiting faster search times and more anticipatory looks to targets that appeared in repeated arrays. Infants' RT latencies decreased more substantially (i.e., more negative slopes) when search arrays were repeated than newly generated, indicating that the benefits of a stable context emerged through learning. This initial demonstration of contextual cueing effects in young infants indicates that they are able to orient attention to different locations and maximize search efficiency using rapidly acquired top-down knowledge.

**PS3-02**

**Is it really there? Absence of gaze cue-validity effect in 5-month-old infants**

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Research and clinical practice with a focus on social behavior often assume that infants are capable of gaze following, but there is evidence that gaze following in the first year of life only occurs under specific circumstances. In the present study it has been investigated in a large sample of infants (N=61; Mean age = 5.1 months) whether the presence of global or local visual information might be a requirement for the cue-validity effect in infants. A gaze-cueing task was used, in which a centrally presented face cued (valid or invalid) the location of a peripheral target through a gaze shift. The faces contained only global, only local or all (unfiltered) visual information. Infants' saccadic reaction times showed no cue-validity effect in either the global, local or unfiltered condition (all  $p > .1$ ). This indicates that the large sample of 5-month-old infants in the present study do not show gaze cueing. Based on these results, one might conclude that the cue-validity effect in infants is not very robust or more specific than previously thought. Further research should focus on replication of the previous studies that did find gaze cueing in infants and on determining the factors that are necessary and sufficient for eliciting gaze cueing.

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**PS3-03**

**Investigating the role of reward for infants' acquisition of gaze following behavior**

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Gaze following is a prerequisite of normal joint attention and language development. Theories about underlying mechanisms range from an inborn sensitivity for social stimuli to reinforcement learning (Meltzoff & Brooks, 2013).

Here, we investigate the role of reward for the acquisition of gaze following behavior (Corkum & Moore, 1998) in 4-month-olds using a gaze contingent eye tracking paradigm. In baseline, infants saw a face looking at one object while looking away from another one. We measured looking times to the cued and the not cued object to investigate if infants followed the cue spontaneously. In a training

phase, infants were rewarded for gaze following or the opposite behavior: whenever the infant looked at the cued object (Study 1) or the not cued object (Study 2), this object started moving lively. The final test phase was identical to baseline. If infants learn through reward, they should change their looking behavior from baseline to test.

In both studies, infants preferred the cued to the not cued object in baseline and test  $F(1,40)=40.21$ ,  $p<0.001$ ,  $\eta^2=0.501$ . While infants in Study 1 increased this behavior in test dependent on the reward they experienced during training ( $r=0.54$ ,  $p=0.011$ ), we found no influence of reward in Study 2 ( $r=-0.27$ ,  $p=0.240$ ).

Reward shapes gaze following, but we were not able to train infants to reverse their existing tendency to follow eye gaze. Follow-up studies therefore investigate infants' ability to learn about the referential nature of a nonsocial cue whose direction they do not already follow in baseline.



# PAPER SESSION 4

## WORD LEARNING

**PS4-01**

**Infants' Mapping between Words and Number**

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Although infants are able to represent number from early on, it is not until approximately age two that they begin speaking about number. A unique challenge that number words pose to language acquisition is that, unlike most other words that children learn at a young age, number words are used to describe the quantity of a set of objects, not any one property of the object itself (Wynn, 1992). No work has explored whether infants readily map words to specific set sizes, or even just to sets of objects.

In the current series of studies, we presented 12-14 month olds with two distinct images (two single objects, or two arrays of items) which were consistently labeled with a distinct verbal label. In preferential looking test trials, infants were presented with both images and heard one of the verbal labels. Despite successfully acquiring the mapping for single objects in this paradigm ( $p < .05$ ), when infants were presented with sets of objects, they repeatedly failed to acquire a set-word mapping. In contrast, slightly older infants (18-22 month olds) had no difficulty mapping words to sets of objects.

Together, these results provide strong support to indicate that while 12-14 month old infants are capable of mapping words onto single objects, they do not understand that a single word can also refer to set cardinality and it is not until about 18 months of age that they have learned this concept.

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**PS4-02**

**The meaning of life: arbitrariness and reference in word and action learning**

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Successful communication often involves comprehension of both spoken language and observed actions. While even very young infants can learn associations between actions and objects (Hunnius & Bekkering, 2010) as well as between words and objects (e.g., Bergelson & Swingley, 2012; Mani & Plunkett, 2008), the extent to which infants preferentially associate objects with linguistic or non-linguistic information remains as yet unclear.

In the current study, 12- and 24-month-olds participated in an eye-tracking paradigm consisting of a training and a test phase. In eight training trials, infants were presented with two novel



objects presented in motion accompanied by a novel label (e.g., blue object called “Tanu” moving up and down). Across twelve test trials, infants were then tested on their learning of the different association dyads (word-object, action-object, word-action). After one week, infants’ retention was tested in the same manner. In addition, vocabulary and fine motor skills were administered offline.

Analyses indicate that infants looked longer to the target object in word-object trials than in action-object trials, suggesting that word-object associations appear to be more dominant, also at retention. These results are in line with previous research suggesting that words appear to be highly relevant markers in early language acquisition. However, this might be due to the actions’ arbitrariness (similar to the sound of words) while goal-directed actions include additional meaning (similar to the reference of words), and might therefore be easier to learn. This cross-domain comparison provides new perspectives for current theories on both word and action learning.

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**PS4-03**

**Maternal speech boosts novel word learning: electrophysiological and eye-tracking evidence from two infant samples**

Caroline Junge

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The maternal voice is special. It is the only voice that neonates have most experience with and prefer over any other voice. Infants further process her voice faster and increase activation in brain areas related to language and attention. Maternal speech also facilitates word processing: in challenging situations, infants only recognize words uttered by their caretaker (compared to an unfamiliar person; word-forms: Barker & Newman, 2004; known words: Parise & Csibra, 2012). But does this advantage also extend to novel word learning? The current paper addresses this question in two ways. rnFirst, we used ERPs to capture the learning process of word learning in 11-month-olds (n=44). Half listened to their own mother’s voice; others listened to the same pre-recorded stimuli (e.g., for them, unfamiliar voice). For word encoding, we examined the N200-500, sensitive to word-form repetition (Junge 2012). Both voice conditions show an increase of N200-500. This increase is larger in the maternal voice condition, mainly driven by the first block of words. This finding possibly reflects that infants treat mother’s first occurrences of novel words as highly unfamiliar.rnSecond, we used eye-tracking to test two-year-olds’ (n=73) word-learning abilities in a live setting (design closely followed Ma et al., 2011). Results show again an advantage for maternal speech: children who learn from their mothers already show evidence of word understanding at first test registration, while other children required additional exposures to the novel words. rnTogether, results show that maternal voice boosts both word encoding and word-to-object mapping.



PAPER SESSION 5  
THEORY OF MIND

**PS5-01**

**How robust and replicable are implicit Theory of Mind tasks? Criticism and alternative explanations**

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Research with implicit methods suggests that theory of mind (ToM) may operate earlier in ontogeny than previously assumed. Several variations of change-of-location false belief (FB) tasks have found that subjects anticipatorily look where a protagonist will act in accordance with her beliefs. Our current study aimed to systematically replicate and extend implicit ToM paradigms. Fifty-three children (M=5.02years) and 42 adults were tested in two different ToM tasks: the Surian (2012) task including true belief (TB) controls and transfer of the object and the Southgate (2007) task involving removal of the object, and no TB control condition but two FB conditions (FB1/FB2) differing in complexity. The results reveal that the findings from the more stringent Surian task could not be replicated with either age group: subjects' AL did not differ between TB and FB conditions,  $F(1, 364)=0.01, p=.915$ . The less stringent Southgate task could largely be replicated for adults,  $t(11) = 2.27, p=.044$ , but only partially (FB1) for children. The tasks did not correlate, challenging the idea that they measure the same underlying concept  $r(62)=-.124, p=.337$ . A follow up study (15 pre-schoolers and 23 adults) extends these findings by administering a new TB control identical to FB1 except that the protagonist witnesses everything. Results show the same AL in this TB control,  $t(37)=3.60, p=.001$ , as in the FB1 condition, suggesting that AL in the FB1 condition does not necessarily reflect FB-ascription. Taken together, these findings indicate that the AL tasks are less robust than previously assumed and subject to alternative, more parsimonious explanations.

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**PS5-03**

**A cross-linguistic perspective on mental verbs and false-belief development**

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<sup>2</sup>The Hong Kong Polytechnic University, Hong Kong

English caregivers show a strong bias towards using mental verbs with first-person subjects, producing frequent, semantically bleached phrases like "I think". Children's comprehension of these frequent phrases shows weaker links with false belief than their comprehension of mental

verbs with third-person subjects ("he thinks") (Brandt et al., in press). In Chinese, the use of mental verbs is relatively infrequent and caregivers do not show a bias towards using them with first-person subjects (Tardif & Wellman, 2000). To investigate whether these cross-linguistic differences have an effect on children's false-belief development, we tested 64 Mandarin-speaking children aged 4;6 and 5;7 and compared them to the English children in Brandt et al. (in press). They saw two boxes. Two hand puppets produced mental verbs and complement clauses to indicate which of the two contained a sticker and how certain they were about this ("I/the cow know(s) it's in the red box" "I/the frog think(s) it's in the blue box"). In the first-person condition the puppets spoke for themselves; in the third-person condition the experimenter spoke for them. In a between-subjects design, each child received six trials and took part in four standard false-belief tests. The Mandarin children only passed the false-belief tests around the age of 5;5. This delayed Theory-of-Mind development was accompanied by a delayed development in their comprehension of mental verbs. However, we also found positive correlations between the older Mandarin children's comprehension of false belief and mental verbs with third-person subjects and no correlations with mental verbs with first-person subjects.

**PS5-04**

**Attentional deployment onto the self and the other during mentalising**

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Social interactions require us to flexibly switch between focusing on the others' mental states and our own mental states. So far, little research has investigated how attention is deployed on the self and on the other, also the extent to which this depends on situational factors and dispositional factors. Adult participants performed a belief reasoning task on two separate occasions. Participants were asked to alternately make judgements about another person's belief and their own belief. Results showed that participants tracked the other person's belief even when they knew in advance that they ought to prioritize their own belief, providing new insight into the ubiquity of efficient mental state tracking. We showed that participants computed the other person's belief even when they did not have visual access to the events and had to infer object location transfer from auditory cues. This suggests that the processing of the other people's belief in our task was not brought about by low-level visual associations. Correlational analyses between the belief reasoning tasks and self-reported measures of empathy suggest that tendencies to focus on one's self on the tasks are negatively associated with self-reported empathy occurring in everyday life.



PAPER SESSION 6  
NUMBERS

**PS6-01**

**Linguistic pathway to multiplication**

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Whereas it is well-known that preschoolers can perform intuitive addition and subtraction, it is an open question whether children can multiply before schooling. We claim that the interpretation of sentences like (1) *Mindhárom néni két kutyát sétáltat* 'All three women are walking two dogs'; (2) *Három néni is két kutyát sétáltat* 'Three women each are walking two dogs'; (3) *Három néni két-két kutyát sétáltat* 'Three women are walking two dogs apiece' involves multiplication: the numeral in the subject is the multiplier and the object is the multiplicand, as many copies of which has to be added up as specified by the multiplier. We tested the interpretation of such sentences with 101 children aged 5-7. After listening to a sentence, the child was told to act it out with toys, and was asked how many toy figures (e.g., in case of (1), how many dogs) she would need to set up the situation. 30% of children could calculate multiplication at the age of 5, and 71% at the age of 7. Children understand the procedure of multiplication before they are able to calculate the product mentally. 24% of the children solved the tasks by multiplying the set of real toys representing the multiplicand, and counting them; 30% multiplied sets of their fingers; 46% could calculate the result mentally. The proportions of the three strategies changed with age. We conclude that the cognitive and linguistic aspects of quantification are inseparable; children learn the algorithm of multiplication as part of language acquisition.

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**PS6-02**

**Counting and the acquisition of the concept of cardinality**

Pierina Cheung, Madeleine Barclay, Sifana Sohail, Jordan Ellman, Natalie May, Anna Shusterman  
Wesleyan University, USA

When do children acquire a concept of cardinality? On the continuity hypothesis, innate nonverbal counting principles correspond with verbal counting principles. On the discontinuity hypothesis, children acquire cardinality only after they have constructed the counting principles. Evidence for these hypotheses comes from different studies, with comprehension studies providing support for the continuity view, and production studies for the discontinuity view. The present study aimed to address this debate using a within-subject design.

Experiment 1 tested 42 3- to 5-year-olds. In the comprehension task, children watched as a puppet counted on a computer; the puppet sometimes counted correctly and

sometimes incorrectly. Children were asked whether the puppet was silly. We found that children who could count to generate sets of objects performed significantly better on the comprehension task (80.2%) than non-counters (45.9%, $p<.001$ ), even after controlling for age. Experiment 2 asked whether children rejected a puppet's miscount because of procedural or conceptual understanding regarding cardinality. The experimenter requested the puppet put in  $N$  objects, and asked whether there were  $N$  (e.g., Are there 8 fish in the bucket?). The puppet sometimes miscounted but the last word was  $N$ , and sometimes counted correctly but the last word was  $N-1$ . Although counters performed above chance (64.8%, $p=.004$ ), they showed a strong last word bias, incorrectly accepting a puppet's miscount as generating a set of  $N$  if the last word was  $N$ . Together, our findings support the discontinuity hypothesis, but they also suggest that even counters may not have fully acquired the concept of cardinality.

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### PS6-03

## Mapping verbal negation on the representation of absent objects in 18 and 24-month-olds

Eszter Szabo, Agnes-Melinda Kovács

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While there is a rich literature concerning how infants represent the presence of objects, we know very little about whether and how they encode the absence of objects. The purpose of the current studies is to investigate the development of forming such representations based on verbal information. We tested the comprehension of a specific form of negation expressing non-existence (Hungarian 'nincsen'). This special form can express absence of entities – entities not being at a specific location, entities ceased to exist or entities that never existed. In Experiment 1 we tested 18-month-olds' understanding of nonexistential negation in a choice task. An object was invisibly hidden into one of two cups and the experimenter indicated verbally where the object was not. Even at this young age, infants were able to find the object based on the information about the absence of the object. In a second line of experiments we tested 18 and 24-month-olds' understanding of the same nonexistential negation in a single-box searching task. Objects were hidden in a box and then they were retrieved. The experimenter told to the participant that the object was not there ('nincsen') and then they could search in it. If they represented the absence of objects we expected them to search less compared to a control condition. Only 24-month-olds behaved according to this prediction. These results suggest that forming and maintaining a representation of absence in a contrastive sense (not here but somewhere else-Experiment 1) emerges earlier than the non-contrastive one (there is none-Experiment 2).



PAPER SESSION 7  
RESOURCE ALLOCATION  
AND JUSTICE



**PS7-01**

**The Development of Inequity Aversion: Understanding When (and Why) People Give Others the Bigger Piece of the Pie**

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Equity norms are important in human society. Traditional inequity aversion models argue that children become increasingly averse to all inequity as they mature (Fehr, Bernhard, & Rockenbach, 2008). We challenge these models by suggesting that inequity aversion takes different developmental paths, depending on whether the inequity is partial or impartial. The different reactions to these two forms of inequity, partial and impartial, are apparent in an episode of Sesame Street in which Ernie takes a big piece of pie for himself and gives a smaller piece to Bert. Bert responds, “That is not very polite. I mean, if I had two pieces of pie, I’d offer you the big piece and take the small one for myself.” Ernie confusedly replies, “Well... you have the small piece, Bert.” Ernie is missing the point: Bert is not upset about the inequity per se, but is instead upset about what the inequity entails: partiality.

Here we argue that as children mature, they behave less like Ernie and more like Bert; they become more tolerant of self-created disadvantageous inequity (while becoming less tolerant of other partial forms of inequity). In five studies (N=755), we predicted and found that 7- to 8-year-olds were more likely to create inequity that disadvantages themselves than 4- to 6-year-olds; but that the 7- to 8-year-olds were less likely to create partial forms of inequity. These results challenge current models of inequity aversion and suggest that children are partiality averse (Shaw & Olson, 2014) by age 7.

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**PS7-02**

**Like Adults, Children Make Consistent Welfare Tradeoff Allocations**

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Even seemingly simple decisions –like whether or not to share a sandwich–hinge on how much you value another’s welfare relative to your own. This comparative valuation has been termed a welfare tradeoff ratio (WTR), and is estimated by identifying how much of a resource you will forgo to give another a specified benefit. Adults express consistent, target specific WTRs across a wide range of situations. But when does this capacity emerge in development? In two studies, we asked (1) Do children make consistent welfare tradeoffs?

And (2) Do children express different welfare tradeoff ratios toward different targets? We predicted that, like adults, children would exhibit consistent welfare tradeoff rules and would express higher WTRs towards friends than enemies or strangers. In Study 1 (N = 167) and replicated in Study 2 (N = 180), 4 to 11 year olds expressed consistent WTRs and were just as consistent at 4 as 11. In Study 2, children made tradeoffs toward a friend, stranger, and enemy. Children exhibited significantly higher WTRs toward friends than enemies, with strangers in between. We conclude that despite children’s limited experience with complex social networks and resource allocation, they reference a stable WTR when deciding whether to benefit themselves or another and that this rule is parameterized by the child’s relationship with the target. These findings support the evolutionary hypothesis that the emergence of sophisticated forms of social valuation are part of a deep cognitive foundation and are not due merely to learning.

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**PS7-03**

**From punishment to reward: Developmental changes in young children’s restorative justice**

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By 5-years, children prefer individuals who are helpful versus hindering (Kenward & Dahl, 2011), collaborative versus individualistic (Ng et al., 2011), cooperative versus obstructive (Warneken & Tomasello, 2011), and generous versus selfish (McCrink & Bloom, 2009). Although a propensity to help, cooperate, and share is an early fact of human sociality, it is unclear how such tendencies develop into a principled reciprocity that represents a marked qualitative shift in meaning. Restorative justice refers broadly to acts that restore equity between partners with disparate material wealth. Here we investigate whether children transition from retaliatory to compensatory acts to restore justice, even when doing so comes at a personal cost (Robbins & Rochat, 2011). Children (N=84) 3-7 years witnessed a sharing game in which selfish, egalitarian, and generous puppets exchanged tokens. Following, children could engage in costly restorative justice by sacrificing coins from a personal endowment. In two conditions (either Punishment or Reward, both N =42), children could sacrifice to remove or give tokens to the puppet(s) of their choosing. Results demonstrate that by 5-years, children selectively sanction norm violators and reward equitable or generous partners, even when doing so is costly. By 7 years children prefer reward as a restorative mechanism, sacrificing significantly more personal wealth to reward egalitarian/generous protagonists than to punish selfish ones. By comparison, five-

year-olds restore justice primarily through punitive measures. In all, by five years (but not prior), children discriminate between two forms of restorative justice, with compensation eventually favoured over punitive measures.

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**PS7-04**

**Working against unfairness: Absence of disadvantageous inequity aversion in chimpanzees**

Keith Jensen

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An important component of human cooperation may be a sense of fairness. However, some studies have suggested that inequity aversion, particularly disadvantageous inequity aversion, may not be uniquely human. The evidence for this primarily comes from a token exchange paradigm in which subjects refuse to work for a reward if the partner gets a better one. An odd feature of this paradigm is that the interaction is between the subject and the experimenter. Subjects have no control over the outcomes for the partner; rejecting rewards increases, rather than decreases, inequity. Furthermore, the amount of work involved is trivial. To address these concerns, chimpanzees were given a novel task based on the successive negative contrasts (frustration) effect. Importantly, experimenters were not involved in the interaction. Chimpanzees worked on a lever pressing task which delivered the same rewards to themselves and a partner. After 10 days, subjects were then given 5 days of testing in which partners received an increase in both reward value and quantity. Chimpanzees did not decrease effort in response to the surprising upshift in partner rewards. It may be that the token exchange paradigm does not tap into disadvantageous inequity aversion. Pilot work on 5-year-old children using token exchanges showed found a strong trend toward disadvantageous inequity, but no sensitivity to effort. These studies suggest that reward expectation – not social comparison and a sense of fairness – drives responses to inequity in other species. Implications for the evolution and development of inequity aversion in humans will be considered.



POSTER  
SESSION A

**PA-001**

**Is the relevant reading always easier to process? The case of structural focus in Child Hungarian**

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The aim of the study is to experimentally investigate whether the use of a context highly supporting the exhaustive interpretation of structural focus construction could help preschoolers accessing the adult-like reading of utterances like (1).

(1) A farkas [A CICÁT] találta meg. 'It is the cat that the wolf has found.'

The factors that are expected to increase the relevance of the exhaustive reading based on previous findings were the insertion of a preceding question (e.g. Who did the wolf find?), the animacy of the denotation of the focused constituent, and the givenness of potential alternatives.

In the critical non-exhaustive test trials, preschoolers (N=30, mean age: 5;7, range: 3;6–7;5) found utterances with structural focus acceptable in 55% of the test trails, indicating that despite the contextual manipulations, they mostly ignored the requirement of exhaustivity encoded by this sentence type. As the results obtained in this experiment did not differ considerably from those of the previous tasks without any broader context, we can conclude that young children not only have problems with processing this construction type in isolation, but they cannot make use of the contextual factors suggesting that the exhaustive reading is the most relevant one either. Additionally, the fact that such a major change of the experimental setting did not influence children's performance significantly is against the hypothesis that exhaustivity expressed by structural focus is a scalar implicature, the processing of which has been proven to be significantly different in such cases.

**PA-002**

**Do temporal delays in children's responses modify mothers' child-directed actions?**

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Caregivers modify their child-directed actions in a number of characteristic ways, including the proportion of pauses relative to actions, exaggeration, and close proximity, for maintaining infants' attention and improving children's imitation behavior. However, factors related to children's responses that modify the mothers' actions remain unknown. We

focused on the temporal contiguity between mothers' actions and children's responses, and examined whether children's responses affected mothers' actions.

Seventeen mother-child dyads participated in this study. Mean mother age was 34.82 years (SD = 4.07) and mean child age was 20.12 months (SD = 3.50). Mothers were asked to demonstrate dance sequences to their children over a color television monitor under two conditions: live and delayed. Mothers and children could interact with each other as usual in the live condition, whereas a 2-sec time lag was inserted in the delayed condition. During these demonstrations, two markers were attached to both wrists of the mothers, and then their actions were recorded by a motion-capture tracking system. The results of the motion data revealed that the total trajectory length of the wrists in the delay condition increased significantly more than in the live condition, although the children's behaviors such as imitation score and looking times did not differ between conditions. Thus, the mothers' actions in the delayed condition were significantly more exaggerated than in the live condition. The present study showed that the temporal delays in children's responses affected mothers' child-directed actions.

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**PA-003**

**The role of eye contact in acquiring new information**

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Fast-mapping and “natural pedagogy” are two of the mechanisms that have been proposed for the daunting task of acquiring the enormous quantity of knowledge necessary to navigate our social world. The reciprocal influence, if any, of these mechanisms, is currently poorly explored and understood. The current studies investigate the role of eye contact on the long-term acquisition of novel names and facts induced by fast-mapping, in adults and in 5-year-old children. We evaluated the effect of eye contact on the retention of information right after the presentation and at a week interval. We find different patterns of results in children and adults. For adults, eye contact had an impact on the retention of facts, particularly of specific facts. One week after a single exposure to information where the actress made or did not make eye contact with the participants, specific facts were better remembered when presented ostensively. In children, eye contact improves long-term retention of names and facts. Interestingly, after one week, the performance for names was above chance only when the information had been presented by making eye contact. This seems to be in agreement with the “natural pedagogy” theory, which highlights the importance of ostensive cues in encoding object identity. The results suggest that in children eye contact seems to benefit the acquisition of all types of information, but especially object identity, while in adulthood it mainly improves the retention of otherwise meaningless, low-relevance, episodic information.

**PA-004**

**Cross-domain influences of early word and action learning**

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For infants, a good strategy to learn about their surrounding world is to communicate with experienced speakers. Successful communication includes the comprehension of spoken language as well as observed actions. When a caregiver shows a new action to an infant, he or she will not only demonstrate the action for the infant to imitate, but will also use language to describe the action to the child. The infant, in turn, can use this information to learn about the action presented. There is evidence that verbal information presented during action demonstration indeed has an impact on infants' action processing and reproduction of that action. Therefore, information from the different domains might interact in social learning situations. The present research seeks to further enrich our knowledge about this interaction and investigates how different verbal information during action presentation influences subsequent action reproduction.

In a demonstration phase the experimenter will show 18- and 24-month-old infants two actions, each performed with one out of two objects, accompanied by verbal information. This information, depending on the experimental condition, will emphasize either the movement, the object acted upon, both, or none of it. After this demonstration, in an imitation phase, the infants will act on real-life versions of the objects. We expect that the infants will integrate the verbal information into their cognitive action-representation, and therefore we expect differences in action reproduction between our experimental conditions. The planned research will therefore shed light on mutual influences in the early development of language and action.

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**PA-005**

**Infant-directed speech effects in adult artificial grammar learning**

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Artificial grammar learning is often understood as a model of grammar acquisition in child language development. While we know that first language acquisition is facilitated by several characteristics of infant directed-speech (IDS) such as the use of shorter sentences and exaggerated prosody, we know little about how these factors influence learning in adults, and what their relative contribution is to learning different aspects of language. The Starting Small hypothesis assumes that incremental presentation of stimuli

of different length has a facilitating effect on language acquisition. Prosody indicating syntactic boundaries also has beneficial effect on learning a grammar in AGL studies with adult subjects. We examined the effects of these two characteristics of IDS together with their interaction further on the acquisition of a simple artificial language: 1) incremental presentation of strings starting with the shorter ones ('starting small') versus random presentation of strings of different length, 2) presenting the strings with prosody indicating phrase boundaries versus monotonous or arbitrary prosody. We hypothesised that 'starting small' would be more efficient than learning with random presentation, and that prosody indicating phrase boundaries would lead to more successful learning than monotonous or arbitrary prosody. Presenting shorter strings before longer ones lead to significantly higher learning on the task, and the presence of prosody marking phrase boundaries had the same effect, but these beneficial effects were not additive. Our results suggest that characteristics of infant-directed speech may support grammar acquisition in the case of adult learners as well.

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**PA-006**

**Cyberbullying research: A new perspective**

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In the last few years, cyberbullying has become a popular research topic. In our study, we created a new empirical method to explore cyberbullying and further on we took our focus on mentalization. The purpose of our study was to examine which factors (mentalization, empathy, school climate, anger expression style) determine how adolescents react to cyberbullying. An other aim was to discover student's mentalization processes during cyberbullying: what do they think about the victim's emotions, inner states.

113 students (65 boys and 48 girls) participated in the study, their average age was 17,5 (SD=0,73) years. In the first section of the study participants had to answer mentalization-related questions after reading stories about cyberbullying and everyday situations. The second part of the study consisted of the following questionnaires: Cyber Victim and Bullying Scale was used to determine their role in cyberbullying, Interpersonal Reactivity Index to measure empathy, Reading the Minds in Films Test to measure mentalization, Anger Expression Scale, and a questionnaire to explore school climate.

The results of our study demonstrate that mentalization processes are important in connection with cyberbullying: Being a cyberbully was determined by mentalization deficit and negative school climate. Most of the participants deemed the victims to feel humiliated, depressed, frightened, however those who were cyberbullies thought the victims don't feel negative emotions.



Our results about the importance of mentalization in cyberbullying might contribute to better prevention and furthermore the results emphasize the importance of understanding what cyberbullies think about the consequences of cyberbullying on victims.

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**PA-007**

**Looking and reaching preferences for faces in 9-month-old infants**

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Is infants' preference for faces specific to their looking behaviour, or does it also extend to their reaching? To answer this question, pictures of faces and other distracting images (i.e. pictures of cars, mobile phones, and scrambled faces) were affixed to the lid of small plastic containers. The containers were mounted on a sliding frame which, when it was pushed forward, allowed the objects to emerge from behind window shutters. When the infant reached for a container, this was removed from the frame and handed to the infant. Thirteen 9-month-old infants participated in this study. Infants' eye movements during the first 5 seconds of the trial were recorded using a head-mounted eye-tracker, and the identity of the object reached for was coded based on the eye-tracking footage. The results revealed an increased dwell time on faces at the beginning of the trial, and a marginal trend to forage the faces more than the distracters. Infants' proportion of first looks to the faces was not significantly different from the proportion of first looks to the distracters. A significant reaching preference for faces was found. No difference between the dwell time on faces and that on distracters was identified in those trials which resulted in a stimulus being reached for, possibly due to a small sample size. The results replicate previous findings regarding infants' propensity to look at faces, and inform the developmental literature about the factors that might influence reaching preferences in infants.

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**PA-008**

**The connection between pragmatic competence and Theory of mind in bilingual children**

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Theory of mind (ToM) is an important milestone in the development of pragmatic skills, so the present study aimed to investigate the differences of pragmatic competence and the cognitive mechanisms behind it between bi- and monolingual children.

In our earlier study (in other studies as well), we found that bilingual individuals solve ToM tasks based on perspective taking more easily as monolinguals, and that this skill develops faster in bilinguals thanks to the socio-cultural environment. It is assumed that the bilingual socio-cultural environment plays an important role, where the child recognizes that someone uses a different language code, so s/he has a different mental state. In these situations bilinguals must decide which of their known languages will be successful in terms of a proper communication (pragmatic differentiation). Because of this kind of socio-cultural environment ToM develops faster, thus pragmatic competence as well.

We compared 60, 3-4 old children (bilingual Hungarian-Serbian and monolingual Hungarian speakers) using a pragmatic competence test, which was made by Schnell, 2012 and standardized by us (Jávor-Schnell). This test measures verbal and non-verbal ToM ability, metaphor, humor, irony processing and conversational abilities.

We assume that bilingual children will outperform monolingual participants, because of the early bilingual socio-cultural environment, where they are exposed to two different languages, and they always have to choose the language the interlocutor could understand.

Keywords: bilingualism, pragmatic competence, Theory of mind

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### **PA-009**

## **Does group membership affect overimitation in preschoolers?**

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This study investigates whether group membership enhances overimitation in five-year-olds.

In two conditions (each n=28) the child and two experimenters drew t-shirts out of a box before the overimitation-task started. One experimenter drew a t-shirt in the same color as the child's and the second experimenter another color. In the shirts-condition experimenters accepted the result neutrally. In the teams-condition both experimenters expressed joy about the drawn color and announced a competitive game. In a no-groups-condition there was no group formation.

Next, children observed both experimenters retrieve a reward from a transparent puzzle-box: First, one experimenter using non-functional and functional actions, second, another experimenter using only functional actions. In the conditions with group formation the inefficient strategy was performed by the in-group-experimenter and the efficient strategy by the out-group-experimenter. After each demonstration, children removed a reward. In a baseline-condition (n=16) children saw no prior demonstration.

After the inefficient demonstration children in all three experimental conditions performed significantly more irrelevant actions than children in the baseline-condition (no-group-conditions:  $p < .000$ ; shirts-condition:  $p < .000$ ; teams-condition:  $p < .000$ ).

After the efficient demonstration children in the no-group-condition as well as in the shirts-condition did not perform more irrelevant actions than children in the baseline-condition (no-group-condition:  $p=.573$ ; shirts-condition:  $p=.338$ ). Children in the teams-condition performed significantly more irrelevant actions than children in the baseline-condition even after seeing the efficient out group-demonstration ( $p=.001$ ).

Results show that the perseverance of overimitation depends on whether child and model belong to the same group. Emphasized team-membership, but not t-shirt color alone, elicited this effect.

## PA-010

### A longitudinal study on learning spatial language in the first two years

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Parents' use of spatial language and gestures are closely linked to children's spatial language development (Cartmill et al., 2010; Pruden et al., 2011). We ask whether (1) children's early understanding of spatial language influence later parental input and (2) parents' use of spatial language and gestures influence children's later spatial language skills. Turkish-learning children were tested at three time points. Parents evaluated their children's vocabulary knowledge using the Turkish version of Communicative Development Inventory (CDI) at Time 1 (Mage=14.21months, n=35) and Time 3 (Mage=24.45 months, n=22). At Time 2, children (Mage=18.55 months, n=35) played with their parents in a puzzle-solving setting. For parent speech, we classified spatial terms into three categories: (1)'what' information including size, shape, features of objects (e.g., big, circle, edge), (2)'where' information including location, orientation, and deictics (e.g., under, turn, here), (3)motion and spatial verbs. Parents' and children's gestures were coded as referring to one of these categories in the form of pointing, iconic or holding puzzle pieces. Children's verb and preposition comprehension at Time 1 correlated with parents' overall spatial language use at Time 2 ( $r=.45$ ,  $p<.05$ ). Parents' use of the 'what' aspect of spatial language at Time 2 was related to children's knowledge of prepositions at Time 3 ( $r=.58$ ,  $p<.05$ ), but not their knowledge of verbs or overall vocabulary. There was no correlation between parents' gesture production and children's later spatial language. These findings suggest that parents adjust their spatial language based on children's spatial knowledge that will also relate to children's later spatial language.

**PA-011**

**Motor ability and social interaction skills enable infants to help**

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Infants start to help others in the beginning of the second year. Although helping behaviors are often interpreted as indicators of infant's early altruistic tendencies, the cognitive and motivational underpinnings underlying early helping behavior are still unclear. In the present study we show that 16-month old infants' helping behavior is intended to benefit others, indicated by the close link between infant's understanding of other's needs and their helping behavior. Importantly, the link established by infant's fine motor abilities and social interaction skills. Thus, this findings indicate that infant's motor and social interaction skills enable to put their understanding of other's needs into prosocial actions. In addition, infant's fine and gross motor abilities as well as their social engagement with the experimenter were closely related to infant's helping behavior. We assume that their motor skills provide infant with an emerging awareness for their competencies to help others in need. It may be not only the prosocial intention, but also an awareness of themselves as helper and the motivation to interact with others socially that take important role in the emergence of infant's helping behavior.

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**PA-012**

**The role of nonverbal behavior during book reading on language development**

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Parents' verbal input during joint book reading is related to children's language development (de Temple & Snow, 2003). Also, gesture use by the parents in joint book reading sessions correlates with children's later language production (Rowe & Pan, 2004; Rohlfing et al., 2015). In the current study, we examine the role of representational gestures and other nonverbal prompts (e.g., touching the book for attention) during joint book reading sessions on children's later language development. Additionally, we also ask whether parents use different nonverbal behavior based on children's earlier vocabulary knowledge.

Thirty-five children between the ages of 16 and 21 months (M=18.30, SD=1.57) participated in a book reading session with their parents. Both parents' and children's

nonverbal behavior were coded and classified as: representational gestures (pointing and iconic), directed touching (touching the book to draw attention), holding the book, free play (hands moving not in relation to the book content). Parents evaluated their children's vocabulary knowledge at two time points (4-5 months prior to and after these sessions), using the Turkish Communicative Development Inventory (CDI).

Preliminary results showed that parents' nonverbal prompts such as directing attention for objects on the book correlated with children's use of the same strategies during joint book reading  $r(35) = .577, p = 0.01$ , and was related to children's earlier word comprehension,  $r(35) = .504, p = 0.01$ . Parents' representational gesture use did not correlate with the language measures. Detailed speech and gesture coding is currently underway. The preliminary findings highlight the importance examining various nonverbal behavior on children's language development.

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**PA-013**

**Task-Switching and Modality-Shifting across Development**

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The ability to direct attention at will in a multisensory environment underlies cognitive flexibility. Using unimodal task-switching (UTS) and cross-modal task-switching paradigm (CMTS), the study explored developmental changes in attention control of switching between tasks and shifting between modalities.

We carried out two experiments with 4-year-olds, 6-year-olds and adults: unimodal visual task-switching (N=73) and cross-modal task-switching (N=76). In both experiments, participants were asked to press a key whenever they detected the target category. There were two conditions— a pure condition involving a single target category, and a mixed condition involving frequent switches between two different target categories. All stimuli in UTS were visual and all stimuli in CMTS were audiovisual. The stimuli were pairings of two incongruent stimulus categories (e.g. a dog picture paired with a car picture in UTS, or a visual 'dog' with a 'sheep' sound in CMTS). Response latency costs in task-switching (vs. task-repetition), and modality-shifting (vs. modality-repetition) were analysed.

Task-switch cost was significant ( $p < .001$ ) and was larger for younger children, indicating that the efficiency in switching to a different mindset matures with age. There was also a modality shift cost ( $p < .001$ ), but there was no interaction with age. Modality shift cost was asymmetric, as it was found only for auditory targets but not visual targets.

Overall, the study revealed that only task-switching was dependent on developmentally-sensitive endogenous control, but not modality-shifting. Across all ages, shifting attention to visual targets incurs less modality-shift cost than shifting attention to auditory targets.

**PA-014**

**Infants expect giving and taking to cue mutually exclusive social relations**

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Recent findings suggest that infants interpret giving and taking actions as cues to social relations regulated onto different and mutually incompatible relational models (equality matching and communal sharing, respectively: Tatone & Csibra, 2013). If so, infants should expect a social relation to be supported by only one type of transferring action, since multiple actions would otherwise cue mutually contradictory models. Across five looking-time studies, we tested whether 12-month-olds use this “principle of relational consistency” (PRC) in determining the number of dyadic relations that an agent participates in.

In Study 1, infants were familiarized to two separate events involving an agent emerging from behind the occluder, giving or taking an object to/from a patient, and going back behind the occluder. At test, infants saw a new agent interacting twice (by giving and then taking) with a new patient. At the end of the second action, the occluder was removed to reveal one or two (identical) agents. Infants looked longer at the the single-agent outcome, suggesting that they inferred two agents behind the occluder (Giver and Taker), instead of a single one (Giver/Taker), consistently with the PRC. Further studies showed that infants did not individuate agents via trait ascription (a Giver should not be a Taker: Study 2) or efficiency analysis (agents should select the shortest path to approach the patients: Study 3). We are currently exploring whether infants prioritize relational or featural information for agent individuation purposes in the present paradigm (Studies 4 & 5).

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**PA-015**

**When do we learn to fear? A visual search paradigm study on fear acquisition in preschool children**

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Past research claimed that children from as early as 3 years of age detect evolutionary fearsome stimuli (e.g. snake) faster than neutral ones (e.g. caterpillar). It was also shown that they detect modern threat-relevant stimuli faster (e.g. needle) than those they did not have previous experience with (compared to e.g. a gun); or than neutral ones (e.g. toaster). However, the two fearsome categories have never been compared and were only examined with distractors of the same evolutionary age. In the current experiment, we sought to explore the similarities and differences between evolutionary old (snakes, spiders) and modern (knife, gun) threat-relevant cues.

We recruited 34 preschool children, aged 5-7. They watched a series of stimuli and responded on a touchscreen monitor. Nine pictures were shown at a time in a 3x3 grid: Eight of them were neutral distractors of the same category (modern – toasters or evolutionary – flowers); while there was always a fearsome target (gun, knife, snake, or spider).

Strikingly, we found that children could detect both evolutionary old and modern threat-relevant stimuli equally fast. However, there is an interaction between the distractors and the targets. Further analyses revealed that children found evolutionary old threat-relevant stimuli faster than modern ones among modern distractors; however, they were faster to detect modern threats than evolutionary cues among evolutionary old distractors.

These results provide the first evidence that preschool children detect modern and evolutionary old threat-relevant stimuli at the same speed; while also underline the role of the context during this process.

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## PA-016

### Infants' visual art preferences

Can Carkoglu<sup>1</sup>, Aslı Aktan Erciyas<sup>1,2</sup>, Anjan Chatterjee<sup>3</sup>, & Tilbe Gökşun<sup>1</sup>

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How do young children experience art and what guides their preferences for artwork? Research on how very young children experience art and what influences their preferences in artwork is very scarce. Previous studies mainly focused on categorization of artwork based on abstract elements (Cacchione et al., 2011; Krentz & Earl, 2013). Here, we examine infants' visual preferences of different artwork. In particular, we asked whether Turkish-reared infants prefer to look longer to abstract art compared to representational art after a very brief exposure to each type of painting. Using a preferential looking paradigm, 24 14-month-olds were first presented a total of 8 different artworks by Monet (representational) and Pollock (abstract). Then, at test infants were presented two types of trials (4 trials in total): within-artwork condition (two Monet paintings or two Pollock paintings were shown) and between-artwork condition (one Monet and one Pollock painting were shown). The trials were counterbalanced. Looking times to the artworks in each test trial were calculated. Results indicated that even though infants were attentive during the entire experiment (looked at the paintings in an average of 79% of their time), they did not have any preference to one type of painting over another in any of the test trials,  $ps > .05$ . This result was not in accordance with the previous categorization findings. In our current work, we try to identify visual attributes that can be universally preferred (such as the balance within the paintings) as well as those that can diverge across development and culture.

**PA-017**

**Incidental leaning and cognitive load in a multisensory environment across childhood**

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Multisensory information has been shown to modulate attention in infants and adults (e.g., Bahrick, Flom & Lickliter, 2002; Shams & Seitz, 2008); and facilitate incidental category learning as early as 5 years (Broadbent et al., in prep). However, during the primary school years, voluntary control of attention is not strongly represented (Ruff & Rothbart, 1996), and the extent to which a concurrent unisensory or multisensory cognitive load would interfere with or support incidental category learning during this time remains unclear.

We examined the role of concurrent task modality on incidental category learning in 5-10 year olds. Participants selected target stimuli whilst also engaging in either a unisensory (visual or auditory only) or multisensory (audiovisual) concurrent detection task (CDT). Here, participants either counted the number of stars (visual), dings (auditory) or dingling stars (audiovisual) that occurred, depending on their allocated CDT condition. Participants subsequently completed a categorical knowledge task to examine the extent of incidental learning of target categories.

Results found that auditory CDT lead to poorer performance compared to audiovisual on incidental category learning, across groups. At 5 years of age, category test performance was at chance in the auditory-only CDT condition, suggesting auditory concurrent tasks may interfere with learning in younger children, but the addition of visual information may serve to focus attention.

These findings provide important insight into the use of multisensory information on incidental learning. Implications for the deployment of multisensory learning tasks within education across development and developmental changes in modality dominance are discussed.



**PA-018**

**Eliciting grammatical knowledge of bilingual children with the help of MAIN**

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Grant RSF 14-18-03668

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Our purpose is to show how MAIN (Multilingual Assessment Instrument for Narratives, Gagarina et al. 2012) can be used for testing grammatical knowledge of bilingual children, with special focus on identifying bilingual features in the children's morphosyntax. It is important for speech therapists to be aware of the underlying problems of the children's language abilities in order to guide intervention process and give the children effective assistance. The sample consists of the narratives of typically developing Russian–Dutch and Russian – Swedish bilingual children (age 4–6, n=36). The narratives were transcribed according to the CHILDES conventions (Mac Whinney, 2010) and analyzed quantitatively and qualitatively, focusing specifically on the acquisition of gender and case.

The results show that the children's mistakes are not homogenous but range from (1) those mistakes that are typical for monolingual TD children, to (2) those mistakes that were characteristic of children with SLA, and (3) the mistakes found in SLI population. The mistakes detected as well as the differences between the children are discussed on the background of the amount of input the children received (as reported by the parents). Agreement and case errors have been identified as clinical markers of SLI (Rothweiler, Chilla & Babur 2010). Yet, in our data they were present in a weaker language of TD children as well, which brings new insights in the under-investigated field: the weaker language of typically developing bilingual children (without language pathology).

**PA-019**

**Infant recognition memory for unfamiliar faces with emotional expressions**

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Adults memorize happy faces better than angry faces (D'Argembeau et al., 2003). The present study examined whether or not infant face memory is also affected by emotional facial expressions. Twenty-four infants aged 6, 10 and 14 months participated, and each infant was first presented with a target face with either an angry or a happy expression for 10 s (learning phase). After a 1 min retention interval, the infant was presented with a

target face and a novel face side by side with neutral expressions (test phase) for 20 s. The novelty preference score (NPS) was calculated, which is the percentage of the total looking time in the test phase that the infant spent fixating on a novel face. A 3 (Age: 6, 10, 14 months) X 2 (Emotion: angry, happy) two-way ANOVA on the NPS indicated the Age X Emotion interaction ( $p < .05$ ). Subsequent analysis revealed that 6-month-old infants had a higher NPS when they learned a face with an angry expression than one with a happy expression. In contrast, 10-month-old infants had a higher NPS when they learned a face with a happy expression than one with an angry expression. The NPS for 14-month-old infants remained unchanged whatever the expression. The opposite results with 6- and 10-month-old infants may reflect the development of an understanding the meaning of facial expression, i.e., 6-month-olds memorize angry faces better because the expression is merely unfamiliar and interesting whereas 10-month-olds understand the emotional attributes of the expressions.

## PA-020

### **Socio-pragmatic competence and cognitive abilities: Preliminary data from the Finnish Pragma test on a sample of Italian normally-developing children**

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Socio-pragmatics refers to how language is used for communicative purposes in specific contexts. It's a complex ability, involving cognitive abilities and social cognition (Cummings, 2009). Such components develop with age making children able to deal with more sophisticated communicative phenomena, such as deceit or irony (Bosco et al., 2013). Despite the relevance in the diagnosis of social (pragmatic) disorder (DSM-5; APA, 2013) the exact role of cognitive components in pragmatic abilities is not clear yet. Aim of the study is to present preliminary data concerning the development of socio-pragmatic performance and its relation with other cognitive abilities. 80 Italian normally-developing children, 4-8 years of age, were tested through the Pragma test (Loukusa, 2009), adapted from Finnish within the present study to investigate children's understanding of contextual and social meanings. Neuropsychological profile was assessed with Nepsy-II (Korkman et al., 2007) in terms of language, attention, memory, theory of mind and social perception. Preliminary analyses regarding the pragmatic performance show an effect of both the type of tasks ( $F = 26.7$ ;  $p < .001$ ) and the age ( $F = 78.88$ ;  $p < .001$ ). Moreover, strong correlation between pragmatic and cognitive performances were detected ( $.76 < r < .87$ ;  $p < .001$ ). Such data

represent an important baseline to better understand the relation between pragmatics and cognitive profile in pathological conditions. Moreover, since data from an analogues Finnish sample are also available, they also provide useful information in a cross-cultural perspective, allowing the comparison of cultural factors and their consequent variability.

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**PA-021**

**From 7 years, children’s asymmetrical estimations of gains and losses predicts sharing behaviour**

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We investigated whether affective forecasting—such as overestimating negativity associated with having less (loss aversion; Kahneman & Tversky, 1986)—motivates children’s sharing. Sixty children (3-7 years) learned to accurately estimate the height of white sand in a transparent tube as 1 scoop (60mL) was added (gain) or removed (loss). Next, a sleeve fit over the tube rendered it opaque, and plain white sand was replaced with valuable, “magical” blue sand that could be exchanged for desirable prizes. In successive conditions, children estimated gains/losses for themselves and a partner. In a counterbalanced sharing task, children also distributed “magical sand” between themselves and their partner. Based on early emerging biases to negative outcomes (Vaish et al., 2008), we anticipated children would overestimate losses relative to gains, and that this overestimation would predict selfish sharing. In general, and controlling for conservation reasoning, children were more accurate estimating another’s gains/losses than their own. 3-year-olds significantly overestimated personal gains, whereas 5 year-olds overestimated losses. At 7 years children demonstrated true loss aversion by significantly overestimating loss while simultaneously underestimating gains for themselves, but not others. Additionally, the magnitude of asymmetry between personal loss/gain estimations predicted sharing behavior: children who overestimated loss were more selfish. Our results suggest the tendency to self-maximize may be partly based on children’s over-inflated perception of personal losses relative to gains. That this asymmetry does not apply to estimations made for others may explain why young children tend to be more equitable in third party sharing (Olson & Spelke, 2008).

**PA-022**

**Children’s Expectations About the Homogeneity of Out-Groups: Evidence From Their Sampling Strategies**

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Adults are prone to represent out-groups as more homogeneous than in-groups. We tested whether this so-called “out-group homogeneity effect” holds true for children, by assessing the type of sample – homogeneous or heterogeneous – children choose in order to make inferences about properties of a whole group (either in- or out-group).

Five- and eight-year-old Israeli Jews (n=71) were confronted with a series of questions, each asking whether a particular property was true of an entire group. To answer, they could assess one of two given samples: a homogeneous (e.g., “these three fathers”) sample or a heterogeneous (“this father, this child, and this grandfather”) sample. Thus, the type of sample children chose for their inferences was the crucial outcome. Half of the questions were about children’s in-group (Jews) and half about a salient out-group (Arabs); half of the properties were biological traits, and half were psychological.

Overall, 8-year-olds selected more diverse samples than 5-year-olds,  $F(1,69)=8.52$ ,  $p=0.005$ . More importantly, across ages, the analyses revealed an interaction between group-membership and trait-type. Specifically, when asked about biological traits, children chose the homogeneous samples more often for questions about the out-group compared to questions about the in-group,  $F(1,69)=5.68$ ,  $p<0.05$ . This is consistent with the notion that children believe that in their biological essences, out-group members are more alike than in-group members, and therefore the former do not require a diverse sample in-order to generalize about the whole group. This bias is consistent with an essentialist construal of out-groups.

**PA-023**

**Preschoolers attribute relative physical and social power from faces and postures**

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Children are sensitive to interpersonal dominance, but it is unclear whether they distinguish between physical and social power. For instance, although preschoolers rate some faces as “stronger” than others (Cogsdill et al., 2014) and expansive bodily postures as being

“in charge” (Brey & Shutts, 2015), possible connections between these impressions are unknown. We investigated this issue in two ways.

In Task 1, 3-, 4-, and 5-year-olds and adults (N = 32/10/24/32 of 32) viewed paired images of people varying on face structure or posture. In a prior norming study, adults had rated the characters individually as high or low in “dominance”. Here, participants labeled which person was “stronger” or “in charge”, without feedback. Four- and 5-year-olds (but not 3-year-olds) chose the expected characters for all stimulus-category/power-type combinations. Adults chose the expected character except when attributing strength on the basis of posture. Task 2 assessed whether the same children were sensitive to potential correspondences between facial and postural power cues. Four- and 5-year-olds (but not 3-year-olds) matched cutouts of the faces and body images in the anticipated fashion.

These findings provide insight into the conceptual organization of children’s developing notions of power. Around 4 years, children infer both physical and social power from both facial and postural information. Moreover, their facility at the matching task suggests that these cues evoke power representations in a common format, or at least formats similar enough to be aligned. Finally, adults’ later restrictions on some power inferences hint at subsequent revision of specific cue/attribution associations.

**PA-024**

**Preverbal infants affirm third party interventions aiding victims from aggressors.**

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Protective interventions by a third party on the behalf of others are generally admired, and as such are associated with our notions of morality, justice, and heroism (Darley & Pittman, 2003; Kinsella, Ritchie, & Igou, 2014; Walker & Henning, 2004). Indeed, stories involving such third party interventions have pervaded popular culture throughout recorded human history (e.g., myths, books, and movies). The current developmental picture is that we begin to engage in this type of intervention by preschool age. For instance, 3-year old children intervene in harmful interactions to protect victims from bullies (Vaish, Missana, & Tomasello, 2011), and furthermore, not only punish wrongdoers but also give priority to helping the victim (Riedl,

Jensen, Call, & Tomasello, 2015). It remains unknown, however, when we begin to affirm such interventions performed by others. Here we reveal these developmental origins in 6 and 10-month old infants (N = 132). After watching aggressive interactions involving a third party agent who either interfered or did not, 6-month old infants preferred the former (Ex. 1). Subsequent experiments confirmed the psychological processes underlying such choices: 6-month olds regarded the interfering agent to be protecting the victim from the aggressor (Ex. 2-4). These findings shed light upon the developmental trajectory of perceiving, understanding, and performing protective third-party interventions, suggesting that our admiration for and emphasis upon such acts – so prevalent in thousands of stories across human cultures – is rooted within the preverbal infant’s mind.

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**PA-025**

**Limitations in Children’s Induction of the Cardinality Principle: Evidence from the Give-A-Number Task with Higher Quantities**

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According to most accounts of number word learning, when children acquire the cardinal principle (becoming “CP-knowers”), they understand how to use counting to correctly generate sets of any size within their count list. However, previous studies rarely ask children to produce sets larger than six, and thus, the depth and extent of their understanding of large numbers remains undetermined. The current study aims to fill this gap by asking CP-knowers to generate large sets through counting. In two experiments, we tested children aged 3 to 5 with a range of large numbers (7-16) in the Give-A-Number task. Results showed that almost all CP-knowers were able to produce set sizes up to 12, providing support that CP-knowers can apply the counting principles to sets larger than four. However, across both experiments, children could not reliably generate the largest set even when it was within their count list. Together, these findings suggest that, contrary to the frequent assumption that CP-knowers can generate any set size in their count list, children initially generalize the cardinality principle only to a limited range of numbers. Implications for theories of children’s acquisition of counting are discussed.

**PA-026**

**Infants transfer visual responses from rewards to reward predictive cues**

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The goal of learning is to minimize the discrepancy between the brain's stored predictions and new environmental input (i.e., prediction error). A key feature of learning from prediction error is the ability to transfer reward value from a stimulus to reward predictive cues. Using eye-tracking, we investigated whether 7-month-old infants would demonstrate transfer of visual responses from rewards onto reward predictive cues. Twenty infants (M=7 months, 8.3 days) were presented with high and low reward faces (i.e., infant's own mother or an unfamiliar female), and high and low reward cartoons (i.e., colorful, dynamic with sound or gray-scale, static without sound). Rewards appeared in isolation and then paired with unique shapes in 24 randomized spatial cueing trials. Infants looked longer at high reward cartoons than low reward cartoons; critically, this distribution of looking times transferred to the cues, as infants looked longer at cues paired with dynamic cartoons than with static cartoons. Infants' pupil dilations were larger for high reward faces than low reward faces; this pattern also transferred to the cues, as infants' pupil dilations were larger at post-test for cues paired with their own mother's face than with an unfamiliar female face. Different patterns of transfer observed in infants' looking times and pupil dilations may reflect separate contributions of attention and arousal to reward prediction learning. Lastly, infants had faster saccades to cues that preceded high reward faces than low reward faces, suggesting that spatio-temporal learning is modulated by the reward value of predicted stimuli in infancy.

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**PA-027**

**Developmental trajectory of the sensitivity to Gricean Maxims**

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Background: The central claim of the present research is that social-cognitive skills play a significant role in inferential meaning construction. Children passing the False Belief Test are significantly more successful in tasks measuring the recognition of the infringement of conversational maxims. The study also draws up a developmental trajectory of the maxims, revealing the cognitive difficulty of their interpretation, their relative place to each other, and the order they may follow in development.

Aims and method: Preschoolers' conversational skills and pragmatic competence is examined in view of their mentalization skills. We measure preschoolers' ToM performance

with a first- and a second order ToM task, and compare participants' ability to recognize the infringement of the Gricean maxims in view of their social cognitive skills. In doing so we use a measure of linguistic tasks, containing 5 short scenarios for each Gricean maxim.

Results: Theory of Mind proved to be a significant factor in predicting the group's performance and success rates in 3 out of 4 maxim infringement recognition tasks, namely, in the Quantity, Relevance and Manner conditions, but not in the Quality condition. We conclude that ToM has a predictive force of 75% concerning the ability to follow Gricean maxims efficiently.

Conclusions: Our findings confirm that children's communicative competence in social contexts, to some extent, requires the development of higher-order social-cognitive reasoning. The results also reflect the cognitive effort needed for the recognition of the infringement of each maxim, yielding a continuum of their cognitive difficulty and trajectory of development.

**PA-028**

**Young children's coordination patterns of action timing in joint action game**

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Developmental studies have shown that the ability to collaborate in joint action develops around 1 to 3 years of age. However, there is less evidence for the mechanisms by which joint actions are achieved in young children. Previous studies have not focused on a process of achieving joint action with a partner in a truly interactive manner. Here we investigated a process of performing joint action in mother-child interaction to reveal the mechanisms by which joint actions are achieved in young children. The current study examined the joint action performances with their mothers in 2.5-, 3.0-, 3.5-year-old children using a sequential button-pressing game. Mother-child pairs had to push their button in an alternating sequence to move the character up the ladder step by step until it reached the finish line. We analyzed a timing change of one's button press after another's button press as dyadic coordination pattern by cross-correlation analysis. Results showed that the joint action performances of mother-child pairs improved among 2.5-to-3.5-year-olds. However, in the performance of pairs, only mother's performances significantly advanced with their children's development, but not children's performances. Furthermore, we found that the dyadic coordination pattern changed across the development of children in the tendency to entrain timing changes in partner's button presses. These findings suggested that developmental changes in coordination processes of joint action have a significant role to clarify the mechanisms by which joint actions are achieved in young children.



**PA-029**

**The influence of infants' individual preferences and mothers' input**

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Several studies suggest a preference for infant-directed over adult-directed speech (hereafter, IDS and ADS), starting immediately after birth (Pegg, Werker, & McLeod, 1992; Segal & Newman, 2015). However, the reason why infants find it easier to learn from IDS compared to ADS is still under discussion (Golinkoff, Can, Soderstrom, & Hirsh-Pasek, 2015). In an ongoing study (n=16, age: 6.2 month), we investigate infants individual preference of IDS or ADS depending on the input they receive from their mother, in three different experiments. First, mothers are recorded while telling a story in imagined ADS and on a different day, telling the same story to their own child in IDS. Second, a preferential-listening task records the looking times of the child while listening to IDS and ADS. We expect infants to look longer on the screen if their preferred speech register is played. Third, in an eye-tracking experiment, an actor turns towards one of two objects after the IDS vs ADS stimulus presentation, and infants' gaze-following is recorded (cf., Senju & Csibra, 2008). Preliminary results revealed that if the input infants typically receive from their mother tends to be more ADS-like, they will listen longer to the IDS passages ( $r=-0.952$ ,  $p=0.048$ ,  $n=4$ ) and will follow the gaze of an actor during ADS presentation. All in all, the preliminary data suggest that there is a tendency indicating that the input the child receives plays a major role regarding her individual motivation and her ability to learn words from different speech registers.

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**PA-031**

**Stability of Individual Differences in Number Sense Acuity during Infancy**

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Humans and other animals have an intuitive sense of number (Dehaene, 1997), supported by an approximate number system (ANS). Previous studies in children and adults have found individual differences in the precision of the ANS, which correlate with mathematics performance (Halberda et al., 2012). However, little is known about individual differences in the ANS in infancy. In the current study we aimed at a fine grained analysis of individual differences in numerical discrimination during infancy by adopting a method which tests infants at multiple levels of difficulty, similarly to methods used to determine discrimination thresholds in adults and older children. Using eye-tracking, 96 infants were tested on a

numerical change detection paradigm. The task was administered at three difficulty levels, determined by the ratio between the two alternating numerosities (1:4, 1:2 and 2:3). Infants were tested on all three ratios both at 6- and 10-months of age. Preference scores were calculated by dividing looking time to the numerically changing stream by the total looking time to both streams. Results showed that only preference scores on the most difficult ratio (2:3) at 6-months could predict numerical discrimination preference scores on the same ratio at 10-months, indicating that stability in individual differences is primarily found on ratios that are more difficult (2:3), possibly due to better discriminability of the test at this ratio. We also find stability in infants' discrimination profiles, as indexed by the slope of the preference scores across the three ratios, between 6- and 10-months of age.

**PA-033**

**The understanding of false and true belief in two-year-old children – Issue of competence or pragmatics?**

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Explicit false belief tasks have been the litmus test of Theory of Mind (ToM) competences. These tasks show that children acquire a full blown ToM around age four. Using children's helping behavior as an implicit response measure, Buttelmann et al. (2009) showed that even 16- to 18-month-olds help the agent according to her false or true belief in location change tasks. Here, in the false belief version the agent is -based on her false belief- searching for an object in the wrong box. In this case the toddler is expected to interpret this behavior as indicating that the agent wants the object and to help her finding it (in the other box). However, in the true belief task the agent is searching in a box she truly believes to not contain the object she was interest in initially. In this case the toddler is expected to interpret her behavior as indicating that she wants something else with the box and to help her to search in the box she targeted. Because of the differences in logic rigor and confounding contrast between the two conditions, we designed more parallel false and true belief helping tasks. Following Call & Tomasello (1999), in this task the toddler is unaware of the object's location. She has to infer the real location based on the agent's searching behavior. Preliminary data shows that 2 out of 5 children in the false belief and 3 out of 4 in the true belief condition solved the given task.

**PA-034**

**the development of food concepts and its relation to food rejections in children from 2 to 6 years of age**

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This research aimed to decipher the suspected relationship between early development of food concepts and food rejection tendencies in young children. We hypothesized that: (i) children’s food categorization and inductive abilities improve between 2 and 3 years of age, (ii) food rejections are interconnected with children’s developing food categorization and induction systems, and (iii) food categorization and inductive abilities are influenced by color as color conveys typicality information of a given food.

We tested these hypotheses with two samples of 2-6 years old children (N1= 79, N2= 126). N1 participants performed a categorization task : they were presented with fruits and vegetables photographs and asked to put in the same box photographs belonging to the same category. N2 participants performed a category-based induction task : they were presented with triads containing one target (a vegetable) and two test pictures (a vegetable dissimilar in color to the target and a fruit similar in color to it) and were told a property about the target and asked to generalize it to one of the two test pictures. We recorded accuracy measures (hit and false alarm rates for N1, number of category-based response for N2), and food rejection scores (measured through a questionnaire).

As expected, the results showed an age-related increase in food categorization and inductive performances. We also found a negative relationship between children’s food rejection scores and their cognitive abilities. Finally, our findings highlighted the central role of typicality in explaining the importance of color in food categorization.

**PA-035**

**The acquisition of recursive possessive structures in Hungarian**

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According to Chomsky (2002) the key factor distinguishing Human languages from animal communication is recursion. Children’s understanding of Hungarian recursive possessive structures was tested experimentally on 22 second grade students (mean age 7;8) in sentence-picture matching task. The research questions were: (i) whether they understand recursive possessives correctly (Hollebrandse & Roeper 2014), (ii) if the salient -nAk

appearing in possessive structures can help children to use recursive forms (diSciullo 2015, Tóth, É.Kiss & Roeper 2016) (iii) whether children adopt a conjunctive interpretation at first which turns into recursion at a later age (Roeper 2011, 2014). After hearing a sentence of the series in (1)-(3), they had to tell which one of pictures A (recursive meaning) and B (conjunctive meaning) sentence describes. (1)?A maci doboza szalagja piros. the teddy bear box-POSS ribbon-POSS red (2) A maci dobozá-nak a szalagja piros the teddy bear box-POSS-DAT the ribbon-POSS red (3)?A maci-nak a dobozá-nak a szalagja piros the teddy bear-DAT the box-POSS-DAT the ribbon-POSS red The meaning of (1)-(3): 'The teddy bear's box's ribbon is red.' The data show that structure (1) is mostly interpreted conjunctively, but structures (2) and (3), in which one or both of the possessors are case-marked, are interpreted recursively (picture A) ( $p=0.003892$ ). We have obtained the following: (i) 7-year-old children can understand recursive possessives; (ii) interpretation is easier in case of sentences (2) and (3) i.e. an intervening overt functional head facilitates the understanding of recursion; (iii) 7-year-old children are prone to interpret recursion conjunctively, and recursively.

### PA-036

## Development of the Evidence Concept: How do the children use this knowledge to justify their arguments?

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Research on argumentation skills has repeatedly shown children's and adults' difficulties to differentiate between theory and evidence. Many of these studies focused on children's skills for evidence interpretation in a scientific reasoning context, showing a quite basic competence in evidence evaluation. Nevertheless, these studies did not consider neither subjects' evidence production, nor they explore their prior conception of evidence. The elicitation of the concept of evidence could play a role in children's argumentation because of the mobilization of metacognitive skills during dialogic argumentation. Consequently, the aim of the present study was to explore the development of the Evidence concept in two groups ( $N=66$ ) of 4th (9-11 years old) and 6th (11-13 years old) grades primary students. Data were collected through an individual semi-structured interview that explored children's ability to justify their opinion based on evidence. Qualitative and quantitative analysis of the content were based on their answer to the question: "Could you explain what an evidence is?" and on how they used this definition to justify throughout the interview. The type of evidence provided was also characterized. Preliminary results showed significant differences between groups in the measures: Concept of Evidence (4thgrade  $\mu=0.64(0.78)$ , 6thgrade  $\mu=1.42(1.06)$ ,  $p=0.001$ ) and Comprehension of the function of the Evidence (4thgrade  $\mu=0.52(0.56)$ , 6thgrade  $\mu=1.06(0.70)$ ,  $p=0.002$ ), being

performance better in the oldest group, which may suggest a developmental trajectory. These differences could explain young children’s difficulties to justify their theories with arguments supported by evidence. Considering children’s conception of Evidence may contribute to improve interventions on argumentation.

**PA-037**

**The Developmental Trajectory of an Anticipatory Looking False Belief Task from Infancy to Preschool-Age - a Longitudinal Study**

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The ability to attribute mental states to other agents is referred to as Theory of Mind (ToM). For decades, it has been believed that a developmental breakthrough in ToM is achieved around the age of 4 years when children start understanding that others can have false beliefs about the world. Recently, however, infants younger than 2 years of age have been shown to pass novel implicit false belief tasks, such as, violation of expectation and anticipatory looking paradigms. It remains a puzzle how infants can display correct expectations of the actions of an agent with a false belief before the age of 2 years, while preschoolers fail standard explicit false belief tasks at the age of 3. The developmental trajectory of the early implicit false belief tasks and their robustness remain a matter of debate. Here, we tested 2-year-old children longitudinally until the age of 4 years in an established anticipatory looking false belief task (Southgate et al. 2007). In our setup, children displayed correct anticipations only by the age of 4 years, while they remained at chance level at the ages of 2 and 3 years. There was a significant developmental change between the ages of 3 and 4 years, at a similar age than the developmental breakthrough in the traditional explicit false belief tasks. We speculate on reasons for this differential developmental trajectory compared to previous anticipatory looking tasks.

**PA-038**

**When are infants aware of the action-effect causality?**

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We investigated five-month-old infants' process of action-effect causality perception by using a digital pacifier. Rochat and Striano (1999) reported that two-month-old infants more strongly sucked a pacifier when the pitch variation was an analog of sucking pressure than

when the pitch variation was a non-analog of sucking pressure. However, the progressive learning process of action-effect causality perception is still unclear. When are infants aware of the action-effect causality? Present study aimed to clarify the process of action-effect causality perception in more detail with a digital pacifier developed in our laboratory, which provides higher time resolution data (50Hz) than data in previous studies (15-30Hz). Infants were assigned two different conditions. In one condition (auditory contingent condition), sound stimulus was presented when the sucking pressure exceeded a certain threshold. In the other condition (yoked condition), infants were exposed a sequence of auditory stimuli pre-recorded in other infant's sucking. The results showed that the frequency of supra-threshold infant's sucking gradually increased in the auditory contingent condition, while it did not in the yoked condition. It suggested that five-month-old infants progressively identify the causal link between sucking and sounds, and using a digital pacifier with a make high time resolution analysis might reveal the dynamic learning process of action-effect causality.

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**PA-039**

**Learning from reliable and unreliable speakers – early roots and cognitive underpinnings**

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Preschoolers selectively learn from previously reliable over unreliable informants (Koenig & Harris, 2005), and even toddlers learn more when information is provided by a reliable speaker (Koenig & Woodward, 2010). While the phenomenon is well documented, less is known about its cognitive underpinnings and early development. Do children encode information from reliable and unreliable sources differently? Are differences in learning from reliable and unreliable speakers influenced by the extent to which these speakers cohere or contradict one another? And to what extent do toddlers rely on the same strategies as preschoolers?

To investigate selective learning strategies in 2- and 5-year-olds, we are using an eye-tracking paradigm. Over the course of several experiments, we examine situations in which previously reliable and unreliable informants offer compatible information, i.e. different novel labels for different unfamiliar objects (Study 1), or contradictory information, i.e. the same novel label for different objects (Study 2), as is more common in the classical paradigms (e.g. Birch, Vauthier & Bloom, 2008).

Data collection is still ongoing, but preliminary data from Study 1 suggest that children in both age groups (2-year-olds: N = 29, 5-year-olds: N = 14) learnt from both reliable and unreliable informants in a situation where they provide compatible information. These

findings suggest that children encode information learnt from both reliable and unreliable speakers. Time course analyses however suggest differences in access to that information, as both 2- and 5-year-olds seem to be slower at identifying a target when it was labelled by an unreliable informant.

**PA-040**

**Identifying a target in hierarchical patterns: does the pattern's density matter?**

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Previous research has mostly focused on studying the preferred visual processing strategy in children and has not attended to the children's ability to use global and local processing strategies in response to the demands of the situation. Our aim was to investigate children's ability to adopt the most relevant processing strategy in order to detect a target shape embedded randomly at the global or the local level of hierarchical patterns. The hierarchical patterns varied in terms of the number of local elements. Efficient performance in this task required an ability to switch between both processing strategies. Our results showed that when the hierarchical pattern consisted of many elemental parts, children's (N= 23; age: 6 to 11) ability in adopting the global or local processing strategy was not significantly different. However, decreasing the number of local elements facilitated local processing. We discussed that children's efficient utilization of processing strategies is context-dependent.

**PA-041**

**Referential Intention Cues in Word Learning and Word Extension**

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Recent findings suggest that the referential intention cues as a component of joint attention facilitate acquisition of a unit in the symbolic system, but have no impact on the word-object association (Kotova&Kotov,2015). However, the role of referential intention in generalization of a novel word remains unclear.

We addressed this question by manipulating referential intention in naming and in demonstration of the object's feature.

In the naming with referential intention(NR) conditions, the artificial label was introduced with the naming phrase. In the naming without referential intention(N) conditions, the experimenter

introduced the label commenting during manipulations with object. In the feature demonstration with referential intention(FR) conditions, the experimenter pointed to the feature and described it, and in the feature demonstration without referential intention(F) conditions, the experimenter turned the object by the side with the feature to the child and commented this.

The mutual exclusivity test was passed only in NR/FR-condition. Thus, intentional attraction of the child's attention to the feature, as well as other referential intention cues, provide an acquisition of unit in the symbolic system.

The comprehension test was passed in all conditions, except NR/FR-condition. The word-object association became difficult when child's attention was attracted to the feature and the entire object as referents of the one word.

Only in N/F-condition the choice of irrelevant object was significantly less than chance level in the word extension test. The referential intention cues do not support the generalization even if they are addressed to the feature as to the basis for the generalization.

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**PA-042**

**Information vs. Affiliation: What drives infants' social preferences**

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Infants prefer to attend to, receive toys from and imitate people who speak the same language as them compared to foreign speakers (e.g. Kinzler et al., 2007). These preferences have commonly been interpreted as early indications of humans' tendency to divide the social world into groups, preferring one's own group and disfavours others. We propose instead that infants' preferences are driven by information-seeking, leading infants to prefer people who provide them with better learning opportunities. In a previous study we have indeed shown that infants treat native speakers as superior sources of information, as indicated by heightened EEG theta oscillations, reflecting an active and selective preparation for encoding information (Gruber et al., 2013).

Given that information in one's own language enables better learning, it follows that infants' motivation to learn would result in preferences for native speakers. However, this preference should not be observed if all speakers provided equally learnable information. To test this, we introduced infants to a native and a foreign speaker, who demonstrated functions of novel objects, while we measured EEG theta activity.

Eleven-month-olds showed no difference in the increase of theta oscillations when they could expect to receive information from the native or the foreign speaker ( $t(15) = 0.540$ ;  $p = 0.597$ ), suggesting that when the information is non-verbal, infants are equally motivated to learn from foreign and native speakers. Ongoing studies, contrasting knowledgeable-foreign to ignorant-native speakers, aim to further elucidate the mechanisms of infants' social selectivity in light of their motivation to obtain information.



**PA-0043****Improving mathematical knowledge with approximate number comparison training in 7-8 year old children.**Nuria Ferres-Forga<sup>1</sup>, Luca L. Bonatti<sup>1,2</sup>, and Justin Halberda<sup>3</sup><sup>1</sup> Universitat Pompeu Fabra, Barcelona, Spain<sup>2</sup> ICREA, Pg. Lluís Companys 23, 08010 Barcelona, Spain<sup>3</sup> Department of Psychological and Brain Sciences, Johns Hopkins University, Baltimore, MD 21218, USA

Recent results suggest that there is a relation between the Approximate Number System (ANS) and arithmetic competence. Currently, much research is devoted to how ANS training can improve performance. However, the exact effects of ANS training, and its potential impact on children with different competence profiles, are still poorly understood. Even at its very beginning, multiple abilities are needed to develop a solid understanding of mathematical problems. Thus, to correctly answer "3+5=□" one has to master an algorithm (addition) without necessarily understanding the nature of the operation. Instead, to correctly answer "3□5=15" one has to understand the nature of the operations, beyond the simple application of arithmetic algorithms. We explored how ANS training influences the acquisition of these competences, and whether it differentially impacts children with different mathematical levels. We trained 7-8 year for three weeks, either with an approximate number comparison task (n=47) or a non-mathematical control task (n=44). We examined how children's abilities changed in applying algorithms ("3+5=□") or in reasoning about operations ("3□5=15"). Overall, training had no main effect. However, it improved the understanding of operations in those children who were initially poorer at applying addition and subtraction algorithms. We speculate that ANS training can improve the awareness of the nature of the operations, a conceptual achievement that can foster a better understanding in solving mathematical problems.

**PA-044****When do we process others' true and false beliefs: An EEG study of adults' spontaneous tracking of others' beliefs**Frances Buttelmann<sup>1</sup>, Barbara Pomiechowska<sup>2</sup>, Ágnes Melinda Kovács<sup>2</sup><sup>1</sup> Department of Pedagogical Psychology, Goethe University Frankfurt, Germany<sup>2</sup> Central European University, Cognitive Development Center - Budapest, Hungary

Although research suggested that adults automatically encode others' beliefs (e.g., Kovács et al., 2010), it is unclear whether in false-belief scenarios participants compute an agent's belief when i) reality starts changing without the agent's knowledge, ii) the change reaches the end-state, or iii) the agent returns to the scene? We investigated this by measuring neural correlates of processing others' beliefs using EEG.

We used an implicit avoidance-false-belief task, where participants observed as an angry animal (e.g., a dog) passed by one box, entered another one and finally jumped into a third box. Their task was to put a target animal (a cat) into one of these boxes while avoiding the dog. In addition a bystander agent was also present. In Study 1, in the false-belief condition (FB) she turned away and thus had a false belief about the dog's final location, whereas in the true-belief (TB) she knew about the dog's location. In Study 2, in a true-belief-update condition (TB-U), she was turned away while the dog jumped out of and back in the same box.

In Study 1, we found (N=15) greater late positive ERP in FB vs. TB at time (i) ( $T+=1.0$ ,  $p\leq.001$ ), suggesting early belief-tracking. In Study 2 (N=15) participants even updated the agent's TB at time (ii) in TB-U, signaled by more positivity compared to TB ( $T+=6.0$ ,  $p=.002$ ). At time (iii) the increase in alpha-synchrony in FB and TB-U vs. TB ( $T+=17.0$ ,  $p\leq.015$ ) suggests that participants inhibited the agent's irrelevant false-belief.

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**PC-026**

**A synthesis of the experimental evidence regarding the dissociable components of executive function skills in childhood: A meta-analysis**

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There is controversy around the topic of executive function skills and whether there are different and dissociable components to this umbrella term. According to Miyake and colleagues (2000) the components of updating, inhibition and shifting are associated but clearly separable skills. Based on Diamond's (2014) distinction of working memory, inhibitory control and cognitive flexibility, we aimed to synthesize all available empirical evidence with children regarding the connection of these components: that is, whether training one skill will have a transfer effect on another one. The following questions were investigated: 1. Is it possible to improve these skills in a young age by making children practice executive function tasks (near-transfer)?, 2. Do training effects transfer to untrained components of executive function (far-transfer)?.

Results of all available controlled experimental studies will be synthesized with samples up to age 12. Effect sizes are computed based on the standardized mean difference between the training and control conditions with the Hedges' g statistics. Preliminary results show that there is a significant near-transfer effect ( $g+ = 0.403$ ,  $k = 31$ ,  $p < 0.01$ ), showing that when children practice an executive function skill, in most cases working memory, they develop on the specific skill. However, we found no far-transfer effect ( $g+ = 0.102$ ,  $k = 17$ ,  $p = 0.26$ ), suggesting that training one executive function component does not transfer to untrained skills. This pattern confirms the theory of dissociable executive function components utilizing experimental data. Differences between clinical and typically developing children will also be discussed.

**PC-028**

**The acquisition of Gender and Case in Russian:  
Russian-Dutch and Russian - Swedish bilingual children  
compared with their monolingual peers with and without SLI.**

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The study presents a cross-linguistic comparison of simultaneous and early successive bilingual children and their monolingual Russian peers with and without language impairment. The emphasis will be made on the acquisition of gender and case in the oral narratives of adults and children.

The sample consists of the narratives of typically developing Russian – Dutch and Russian - Swedish bilingual children (age 4-6, n=60), typically developing Russian monolingual children (age 4-6, n=50), Russian monolingual children diagnosed with SLI (age 4-6, n=50) and adults studying Russian as the second language (students 20-26 years old, n=40).

The results indicate partial similarity between typically developing bilingual children, monolingual children with SLI and adults acquiring Russian as a second language. The ungrammatical forms found in the speech of bilinguals were of three kinds: (1) those that were also present in monolingual Russian children, (2) those found in speakers acquiring Russian as an L2 and (3) those found in the material of Russian SLI children.

Several structural modifications and replacements were found in the children’s narratives in Russian that can be classified as bilingual innovations since they arise as a natural outcome of children’s contact with the two languages. But they cannot be explained by transfer alone since the children made mistakes even when the two languages were structured in the same way. Rather, the bilingual environment as such seems to be the cause of the decreased structural complexity in one language – but not in both.



POSTER  
SESSION B

**PB-001**

**Motion cues to animacy: naive chicks have social preferences for objects maintaining the anteroposterior axis parallel to their motion**

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Elementary features of the motion of a single 2D shape moving on an homogeneous background elicit the perception of animacy in adult observers. Among these features is also the alignment of the object main axis with the direction of motion: objects that maintain their axis consistently aligned with and parallel to the direction of motion are perceived as being “more animate”. This is likely to derive from the fact that in most bilateria the direction of travel is constrained by the orientation of the anteroposterior axis, making this a reliable cue of animacy. Moreover, 6-month-old infants spontaneously encode the orientation of agents’ anteroposterior axis, suggesting an early mechanism for attending to this cue. We employed an animal model to study the evolutionary and developmental origins of these phenomena. In a series of experiments we tested dark-hatched visually naive chicks for their spontaneous approach preferences between two stimuli. Each stimulus was a video-animation of a red cylinder moving on a black background. The object entered the screen already in motion appearing from its upper left corner and moving downward along the diagonal; when it reached the midline of the screen the object’s trajectory made a 90° turn. Chicks showed a significant preference for objects that maintained their main axis aligned in parallel to their motion direction.

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**PB-002**

**Do adolescents take more risks? It might depend on the development of intuitive abilities**

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Previous research has suggested that the altered interplay of outcome evaluation and impulse control is responsible for the increased risk-taking often observed in adolescence. Importantly, learning and adaptation could also play a role in sequential risk-taking. While explicit learning abilities steadily improve with development, implicit learning is decreased at the onset of puberty. Here we aimed to investigate how the co-occurring ontogenetic

changes in implicit statistical learning and risk-taking behavior might be related. We tested a total of 104 participants aged from 10 to 24. Intuitive ability was measured by a statistical learning task, namely the Alternating Serial Reaction Time (ASRT) Task. Risk-taking and adaptivity (changing decisions according to negative feedback) was measured by the Balloon Analogue Risk Task (BART). On average, participants showed a risk-averse pattern, leading to a sub-optimal performance on the BART. Interestingly, we found no age differences in risk-taking. However, adaptivity was correlated with implicit statistical learning performance, so that those who were better implicit learners, took more risks despite a former negative feedback, thus achieving a higher score. This relation was altered by development: while those pre-adolescents who took more risk were better implicit learners, this was not the case among adolescents, and there was even a tendency for the opposite relationship in the group of 14-16-year-olds. In sum, our results suggest that the developmental decrease of intuitive abilities based on statistical learning contribute to how individuals learn and decide in risky situations.

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**PB-003**

**Recognition of Moore-paradoxical sentences in children**

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The present poster reports an experiment on recognition of Moore-paradoxical sentences in preschool and school-aged children. What is Moore's paradox? It is paradoxical to assert that It is raining, but I do not believe that it is raining. So the principle of creating the experimental sentences was that the connection between the two parts of the sentences is a kind of anomaly or contradiction. E.g. I promise that I'll give you a bike for your birthday, but I do not want to buy you a bike.

Our research questions are: When and how do children recognise the paradoxical nature of Moorean sentences? What is the relationship between the developing theories of mind and this recognition? Is understanding of pure logical inconsistency a prerequisite for comprehending the paradox?

Participants were 25 five-year-olds, 23 six-year-olds, 23 seven-year-olds and 25 eight-year-olds.

During the experiment, children had to choose between two speakers the one who said something silly. So, one of the speakers always expressed a paradoxical statement while the other one said a syntactically matched control sentence.

According to our experimental findings, 5-and 6-year-old children are bad at this task while the overwhelming majority of seven-and eight-year-olds could select the Moore-paradoxical sentences from our stimulus material. In other words, there is a clear

developmental pattern in the age range studied in this experiment. These findings show that there are interesting developments in theory of mind reasoning after six years of age in the elementary school period.

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**PB-004**

**Behavioral correlates of logical inferences**

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Logical thinking can be described as the ability to make inferences by manipulating internal representations according to logical rules. The cognitive bases of this fundamental ability are still poorly understood. Here we propose to investigate behavioral correlates of inference making in non-linguistic contexts. Adult participants saw scenes varying in a crucial factor: whether their content can be properly understood by drawing a logical inference. The scenes display two objects, an occluder and a cup. The cup grabs one object either before or after the occluder hides the stage. If it scoops it after the occluder raises, participants cannot know its content. However, when the second object exits the occluder, they could infer it via disjunction elimination. If instead, the cup grabs the object before the occluder raises, participants need no logical inference to gather its content. We studied the temporal course of participants' eye gaze and their pupil dilation during the potential inference phase, by comparing scenes requiring or not requiring an inference to identify the content of the cup. A specific spatiotemporal looking pattern marking inference making emerged. It included an increase in gaze direction towards the cup, accompanied by an increase in pupil size. Importantly, similar scanning patterns were found in 19-month-old infants watching analog scenes. These results reveal behavioral markers of specific logical inferences, potentially offering novel ways to study their neural basis with non-linguistic materials.

**PB-005**

**Infants' understanding of teasing and its effect on a novel social relationship**

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Teasing is playing with the expectations of the other and simultaneously creates and shows intimacy between two persons. However, if a person does not understand the playful intent, then it can be perceived as mean behavior. In the present study, we investigated whether infants differentiate teasing behavior from other playful behavior and whether being teased for infants has a fostering effect on subsequent social interactions.

In a first experiment, we looked at 9, 12, and 18-month-old infants' (total n = 72) ability to understand and differentiate a teasing intention from a trying intention and an outright refuse intention. We measured the duration of smile, gaze, and reaching reactions of the infant. We found that 9 and 12-month-old infants show differential behavior towards the different intentions ( $\chi^2(2; N = 72) = 18.38, p < .001$ ) but only at 18 months did the infants smile more in reaction to the teasing situation than in the other two situations .

In the second experiment, we compared playful and teasing behaviors and examined the social effect of teasing. Conditions involved similar positive emotional cues, the same actions, and the same objects. We tested three different age groups (13-, 20-, and 30-months-old; total n = 68). All age groups smiled more in the Tease than in the Play condition ( $F(1) = 39.67, p < .001, \eta^2 = .45$ ). However, in the affiliation test, no effect on the choice of an interactional partner could be found ( $\chi^2(2) = 2.51, p = .33, \text{Cramer's } V = .25$ ).

**PB-006**

**The Development of the Neural Correlates of Body Schema Processing During**

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Recent studies provide evidence that body expressions evoked similar neural response in the human brain compared to those elicited by faces. EEG studies suggest that, similar to faces, the perception of body postures involves to a good extent processing information about the configurational relation between its different elements (Thierry et al., 2006; Righart & de Gelder, 2007). When this information is altered by changing the orientation



of the bodies (i.e., upright vs inverted), the ERP component N170 is delayed and have a higher amplitude for the inverted bodies compared to the upright ones (Stekelenburg & de Gelder, 2004). However, the body inversion effect has been so far only investigated in adults. Although previous studies show that there are developmental changes in the body schema processing in infants, few study investigated how the neural mechanism develops from childhood to adulthood. Therefore, the current study aims to reduce this gap by showing how the ERP components associated with body schema processing mature throughout childhood. Three- to 11-years-old children were presented with images of human bodies and objects with a similar structure (i.e., hat stands). Both the bodies and the objects were presented with an upright and with an inverted orientation, while continuous EEG was recorded with a 128 electrodes Geodesic Sensor Net (EGI). Results show a reversed inversion effect: opposite to facial inversion effect, inverted neutral body schemas invoke lower amplitude on. This study also provides a developmental account of the maturation of the body schema over childhood.

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### **PB-007**

#### **Developmental origin of involuntary facial mimicry: studies of infants, and children with/without ASD**

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Involuntary facial mimicry (IVFM) is a phenomenon that congruent facial movements are observed when a person is shown the other's facial expression (Dimberg, 1982; Sato & Yoshikawa, 2007; Murata, et al, 2016), which is considered to be an important gateway for studies on social synchrony and underlying empathetic systems. To approach its early development, we investigated 32 infants (seventeen 9-12 month-olds and fifteen 16-19 month-olds), with taking a behavioral method. Each participant was shown dynamic (morphing) facial expressions from neutral to anger / happiness, and the facial reactions were coded with special focuses on AU4 (inner eye brow) and AU12 (lip corner). The results showed that AU4 reacted more frequently in response to angry expressions than to happy expressions, while AU12 reacted vice versa. These indicated that IVFM could be rooted

from infancy. Further, we examined IVFM in ASD children, using dynamic (morphing)/static x happy/anger facial stimuli. Each participant (22/23 ASD and 22/23 IQ and CA matched TD children for dynamic/static stimuli, respectively) was shown stimuli and response in AU4 and AU12 were recorded with wireless EMG. The results showed congruent responses to dynamic stimuli both ASD and TD groups. On the other hand, congruent responses to static stimuli were observed only in TD group. Though further consideration on experimental conditions and techniques between the studies are needed, these results suggested different pathways to lead IVSM for dynamic and static stimuli, at least one is rooted from infancy, and another might reflect the process through representation.

**PB-008**

**Gaze cuing affects the object choices in infants:  
I choose what you look at**

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Human eye gaze is one of the most important signals for nonverbal communication such as joint attention. Joint attention has been shown to be important in social development. In the adult study, it was revealed that the gaze cuing joint attention affects object choice behavior and affective response toward the faces. Here, we examined how eye gaze affects the object choice and the face preference in infants. Sixteen 12-month-old infants were recruited to this study. Participants were shown stimuli in which a female gazed at an object or not. Two female faces and two objects were paired respectively for the Joint Attention condition or the No-Joint Attention condition and counterbalanced in each participant. The results, in the object reaching test, demonstrated that infants chose an object in the Joint Attention condition significantly more than that of the No-Joint Attention condition. On the other hand, in the object looking test, the proportion of looking times for the object in the No-Joint Attention condition was greater than that of the Joint Attention condition. Also, there was a significant difference between the Joint Attention and the No-Joint Attention condition in the face looking test. From these results, eye gaze biases infant object information processing and preference for objects and faces. We showed that only eye gaze has privileged sources of information for object learning and social relationships.

**PB-009**

**Infant gaze following depends on ostensive context: an eye-tracking study of 5-to-7-month-olds in Vanuatu**

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Infants in Western cultures respond to referential behaviors (e.g. gaze-shifts, head-turns) presented in ostensive context (e.g. preceded by infant-directed speech), suggesting early emerging competence in reception of communication. However, given cultural variations in early parent-infant interactions, it is not clear whether such early communicative competencies of western infants reveal universal developmental mechanisms or whether they reflect processes specific to Western populations. We used an eye-tracking paradigm (Senju & Csibra, 2008) to assess gaze-following responses of 5-to-7-months-old infants (n=22) in an indigenous small-scale society of Tanna island in Vanuatu, where face-to-face parent-infant interactions are reported to be less prevalent than in Western populations (Little et al, 2016). Infants watched a series of movies in which a Ni-Vanuatu actress turned her head to one of the two objects in front of her. Each infant watched two blocks (each with a different actress) of up to 12 trials, with a 5-15 minute break between blocks. In one block all head-turns were preceded by infant-directed speech, in the other – by adult-directed speech. We found that – just like British 6-month-olds in the original study – Ni-Vanuatu infants looked at the gazed-at-object rather than the distractor-object when the head-turn was preceded by infant-directed speech, but not when it was preceded by adult-directed speech. These results are consistent with the notions that gaze-following is tied to infants' early emerging communicative competencies and that sensitivity to ostensive referential behaviours may be rooted in mechanisms which are universal, despite variations in parenting styles and socialization across cultures.

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**PB-010**

**Wow! Interjections in the infant lexicon.**

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Within their first years of life, children rapidly acquire a native language lexicon. A fair number of these early words are nouns and verbs. Perhaps as a result, theories of language development have traditionally focused on children's acquisition of words from these classes, sometimes overlooking lexical entries belonging to other categories. Interjections (e.g., hi or uh oh) are particularly understudied: Even though they encompass roughly 30%

of words in infant-directed speech (Johnson et al., 2014), hardly any work has explored infants' sensitivity to these items.

This study uses children's early vocabulary scores (through Wordbank; Frank et al., in press) to assess when children gain sensitivity to interjections and whether early knowledge of interjections is indicative of greater overall vocabulary size. A total of 2077 MacArthur-Bates CDIs completed by parents of monolingual English-, Quebec French-, Italian-, Danish-, Norwegian-, and Russian-learning children between 8-12 months were examined. For each child, the percentage of interjections, nouns, and total number of words produced as a function of CDI size was computed. Correlation analyses between produced interjections and total productive vocabulary size (as well as between produced nouns and total productive vocabulary size) were conducted for each language at one-month intervals.

As expected, early acquisition of interjections was positively correlated with greater overall vocabulary score for all languages. Interestingly, the strength of this correlation was similar to that between nouns and overall vocabulary size up until 9 months of age. Thus, early on in life, producing interjections may be indicative of a relatively large lexicon.

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**PB-011**

**Rudimentary sympathy in children and adults: Effects of culture and community on preference for others in distress**

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Preverbal 10-month-old infants show sympathetic responses as their preference for others in distress (Kanakogi et al., PLoS ONE 2013). We aimed to investigate if the preference for others in distress changes in development, and is affected by cultural and community differences. In Experiment 1, fifty-two university students (2 females, 50 males) in Japan observed eight trials of aggressive social interactions between a victim and an aggressor, and rated their preference of the victim against the aggressor. We found that they preferred the victims rather than the aggressors ( $p=.0011$ ), suggesting the consistent preference throughout development. Subsequently, we examined the effects of culture and community on the preference. In Experiment 2, thirty-two 12-year-old elementary school's students

(all females) in an urban area in Malaysia viewed the identical stimuli, and showed the preference for the victims ( $p=.0030$ ). In Experiment 3, forty 12-year-old elementary school's students (20 females, 20 males) in a rural area in Malaysia viewed the identical stimuli, and did not show the preference for the victims ( $p=.6195$ ). The aggressors were preferred by males than females, but not significantly ( $p=.1242$ ). The preference for the aggressors was stronger for males in the rural area in Experiment 3 than females in the urban area in Experiment 2 ( $p=.0014$ ). These results suggest that the preference for others in distress would be universal, but affected by community and gender. To further investigate those effects on rudimentary sympathy, we need to obtain data of elementary school's students in Japan and university students in Malaysia.

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**PB-011**

**A new look at joint attention**

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Everyone agrees that joint attention is a key part of human social cognition. Yet, despite over 40 years of work and hundreds of publications on this topic, there is still surprisingly little agreement on what exactly joint attention is, and how the jointness in joint attention is achieved.

Here we take a new look at joint attention and systematically distinguish it from several closely related but clearly distinct phenomena. First, we outline a typology of sharing attention and introduce five levels: individual, parallel, common, joint, and shared attention. We then consider cognitive, behavioral, and phenomenological aspects of the different levels of sharing attention and discuss some of the different consequences of these. A key distinction we focus on here is second-personal vs. third-personal relations.

Second, we introduce the idea that the higher attention levels exist on a continuum of sharedness (i.e., in terms of how much the other is in mind, the certainty that attention is shared, and connection with others) and describe several factors (e.g., goals, saliency, timing and contingency, the individuals' behaviors) that can cause shifts in the continuum. Finally, we extend the typology to include joint action, and we consider what levels of sharing different types of individuals (typically-developing infants, children, and adults, children with autism, animals, and robots) can achieve.

**PB-012**

**Shared book reading enhances child language development?  
An interventional study.**

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Background: Many researchers have advocated that household shared book reading in infancy or toddlerhood enhances children’s language abilities (e.g., DeBaryshe, 1993). However, these studies examined just correlational data between spontaneously shared book reading and language development, not their causal associations. This study empirically investigated the effect of increasing shared mother-infant book reading frequency at home on child language development by assigning to either experimental (shared book reading) group or control group.

Methods: Forty-five nine-month-old infant and mother pairs were randomly assigned to either the shared book condition (21 pairs: 11 males) or the passive control condition (24 pairs: 12 males). After the free play session for nine-month-olds, the mothers in the shared book condition were instructed to share picture books with their infants at least once a day. The mothers in the control condition were given no instructions. All the mothers filled questionnaires for household book and television use and language development (MacArthur Communicative Development Inventory: CDI) when children were 12- and 30-month old.

Key Results and Discussions: The analyses of variance (ANOVAs) showed no significant difference between the two conditions. However, there were some positive correlations between household shared book reading time and some CDI items when the infants were 12-month-old and negative correlations between household television watching time and them when they were 30-month-old. These results indicate that shared book reading at home may enhance child language development in infancy, and that watching television may be detrimental for it in toddlerhood.

**PB-013**

**Does topology help object individuation?**

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Do infants possess early competence in geometry? Here, we focus on one branch of geometry, topology, which describes highly abstract properties such as whether shapes are connected or disconnected, full or holed. Typically, in a task where they see objects appearing in succession, infants do not rely on “superficial” features such as shape or color in computing object identity. Interestingly, in adults topology changes but not shape or color changes disrupt object tracking, suggesting that topology may play an important role in the computation of object identity in infancy. To test this hypothesis, we designed two experiments where infants were presented with two objects (same or different across trials) emerging successively from behind a screen. The screen was then lifted, revealing only one object. In the first experiment, a pilot experiment, 12-month-olds were tested with a contrast in which they are known to be successful: objects differing in color, shape and the eyes. Results from the first experiment were used to estimate the effect size for our method, and to determine the required sample size for a second experiment focused on topology (N=20, power = 0.98). When tested with a pure topological contrast (full vs holed cube), contrary to our hypothesis, infants failed to use topological information as a cue to individuate objects. Our findings align with a recent report showing that topology interferes with working memory in infants (Kibbe & Leslie, 2016), and may call for a reinterpretation of adults’ results on topology and object tracking.

**PB-014**

**Preschoolers Defend Others’ Right to Claim Knowledge**

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Theory of mind research has mostly investigated children's understanding of non-normative aspects of epistemic states, such as predicting others’ actions based on their belief state (Perner & Roessler, 2012). Epistemic states, however, have a social-normative dimension (Brandom, 1994). Knowing something means to hold a justified true belief: we are entitled to claim knowledge about some state of affairs if we have evidence for it. We investigated whether 3- and 5-year-olds understand the normativity of knowledge and would defend some person's entitlement to claim knowledge against invalid criticism.

Children (N=45) were given a knowledge and fact task. In the epistemic knowledge task, a speaker made justified or unjustified claims. Children had the opportunity to defend the speaker against a second party who protested against the speaker. Five-year-olds performed more counter-protest against the second party when the speaker made justified versus unjustified claims ( $Z=-2.26, p=.023$ ). Three-year-olds hardly showed any counter-protest ( $Z=-0.96, p>.05$ ).

In the non-epistemic fact task, a speaker labelled objects correctly or incorrectly. Children could again defend the speaker against a second party. Three- and 5-year-olds performed more counter-protest when the speaker made correct versus incorrect claims (3ys:  $Z=-3.39, p=.001$ ; 5ys:  $Z=-3.58, p<.001$ ). Thus, 5-year-olds rejected the second-party's protest in both tasks, 3-year-olds did so only in the non-epistemic task.

These findings provide the first evidence that preschoolers understand something about epistemic normativity and that they are motivated to defend others' entitlement to claim knowledge. The current findings may therefore help bridge the literatures on theory of mind and normativity.

**PB-015**

**When does labour lead to love? The ontogeny and mechanisms of the IKEA effect.**

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We frequently elevate our constructions to a special status in our minds. This so called 'IKEA' effect leads us to believe that our creations are more valuable than items that are identical, but constructed by another. In this series of studies, we use a developmental perspective to explore why such a bias exists. In Study 1 we examine the developmental origins of the IKEA effect, demonstrating an emerging bias at age 4, which corresponds with key developmental milestones in self-concept formation. Study 2 examines the role of time and effort investment, and from this we conclude that the IKEA effect does not reflect the amount of effort needed to complete the task. Finally, Study 3 examines the contribution of feelings of ownership to the IKEA effect, finding that feelings of ownership contribute, but do not fully explain why we value our creations more. Together, results from these studies indicate that the IKEA bias reflects a link between our creations and our self-concept, which leads us to value them more positively than the creations of others.



**PB-016**

**Old Doesn't Mean Wise: Not Their Age but Children's Fantastical Beliefs Affect Their Possibility Judgements**

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Children experience difficulty in discerning improbable yet possible events from impossible events, and this ability improves from 4 to 8 years of age (Shtulman & Carey, 2007). Further research indicated that 4-year-old children have an implicit understanding of the difference between improbability and impossibility (Weisberg & Sobel, 2012). While it was shown that children's fantasy orientation (FO) affects their reality-fantasy distinctions (Richert & Smith, 2011), it has not been explored how FO influences their possibility judgments in fictional settings. This study investigates the effects of four FO constructs on children's judgements: Fantastical thoughts, beliefs in fantastical entities, fantasy-themed interests, and pretense engagement (Pierucci et al., 2014).

Three to 5-year-old children (N=143) read a book either with possible, improbable or impossible themed events. They were asked to categorize each event as possible or impossible. Analyses revealed that not children's age but the book theme and children's beliefs in fantastical entities affect their possibility judgements of events. Children are able to correctly differentiate possible, improbable and impossible events,  $F(2,125)=88.371$ ,  $p<0.001$ . Post-hoc analyses regarding the interaction between book theme and entity belief indicate that ( $F(2,125)=5.124$ ,  $p=0.007$ ) children who believe in fantastical entities are more likely to mistakenly find an impossible story possible ( $M=1.708$ ,  $SE=0.25$ ) than children who do not believe in any entities ( $M=0.489$ ,  $SE=0.222$ ),  $p<0.001$ .

This study offers a deeper insight into the role of specific constructs of FO on children's possibility understanding. Results indicate that while preschoolers are able to differentiate improbability and impossibility, their fantastical beliefs affect their impossibility judgements.

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**PB-017**

**“Thinking for Speaking” in Early Childhood: Bidirectional Effects of L1 (Turkish) and L2 (English)**

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This study investigates how learning a second language can be represented in event conceptualization patterns elicited in both L1 and L2. Thinking-for-Speaking-Hypothesis (Slobin, 1996) proposes that speakers of different languages have language-specific ways

in tailoring their thinking. Languages fall into two categories according to how motion events are encoded (Talmy, 1985). English and Turkish fall into two distinct categories according to this categorization. English is a satellite-framed language that conflates motion with manner expressed in the main verb (e.g., climb up) and path in a non-verbal element whereas Turkish is a verb-framed language and conflates motion with path in main verb and manner in a subordinated verb (e.g., tırmanarak çıktı, went up climbing).

One-hundred and twelve 5- and 7-year- monolingual (L1, Turkish) and bilingual (L1, Turkish; L2, English) children watched 12 videos depicting motion events with different path and manner combinations. Participants described each video after watching them, bilingual children described the same events in English as well in a separate session. For L1, at age 5, the percentage of manner verbs were higher ( $p < .05$ ) for bilinguals ( $M = .67, SD = .14$ ) than monolinguals ( $M = .50, SD = .15$ ); however, this difference disappeared for 7-year-olds. For L2 descriptions, both bilingual 5- ( $M = .80, SD = .22$ ) and 7-year-olds ( $M = .69, SD = .22$ ) expressed more manner verbs for the same events compared to their L1 descriptions.

Findings suggest that thinking-for-speaking is observed for bilingual children. Results inform us about the early interactions between L1 and L2 within motion event conceptualization.

**PB-018**

**When the winner becomes the leader**

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Recent research has demonstrated the capacity of infants to represent hierarchical relationships.

At 12 months old infants are able to recognize who is the winner in a conflict situation. Later, at 15 and 18 months old, they consider this role stable across tasks depending on how the winner achieves his goal (Bas, J. & Sebastián-Gallés, N., in prep.; Mascaro, O. & Csibra, G., 2012).

At 15 months-old, infants understand the different roles in a leadership relation (the leader, the non-leader and the followers) and expect that the followers always imitate the actions performed by the leader but not the reverse (Bas, J. et al, in prep.).

Here we study how all this concepts are related and understood by infants. Using an eye-tracker, we recorded 18-month-olds' eye gaze behaviour while watching short animations where one agent observes how another two agents are able to take a ball if they try to do it alone. If they both want to do it at the same time only one of them prevails (always the same agent). After this familiarization, both agents offer to the observer to follow different paths: to go with the "winner" or with the "loser".

We measured the total looking time for both options and preliminary analyses indicate that infants expect the observer to follow the winner rather than the loser (mean-winner= 12,81 sec.; mean-loser= 17,02 sec.;  $p= 0,04$ ). These results suggest that infants consider the success as a feature of leaders. We will further discuss all the implications of this assumption.

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**PB-019**

**Deviant sound processing affected by beat at birth**

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Stressed and unstressed regularly timed pulses form the basis of rhythm which is already processed at birth. The possibly automatic rhythm perception is necessary for synchronizing, taking part in music and arguably in conversation. In the current experiment we have tested whether newborn infants use contextual cues inferred from the stress pattern to modify processing of different types of deviant stimuli.

Event-related potentials were recorded from sleeping infants 2-4 days after birth while they were presented with 15-27 elements long trains of alternating piano (S1) and a harpsichord (S2) tones that had the same pitch and were delivered at the constant 225 ms inter onset intervals. The train started with either the S1 or S2 sound (50-50% probability). As the first sound of a sequence are more accented this manipulation makes the S1 sound either accented (starting on S1) or unaccented (starting on S2) throughout the short train, establishing context. S1 tones were infrequently replaced by either frequency deviants (D) or stimulus omissions (O). The ERP responses to standard as well as deviant tones differed between the two contexts. This suggests that the newborns brain differentiates between accented and unaccented beats based on minimal contextual manipulation. This result provides new insights into the role of attention and gives some support for automatic system in beat perception.

**PB-020**

**Imitative fidelity increases when movements are not directly followed by an external effect in two-to five-year-olds**

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Previous studies have found that children imitate a sequence of actions more faithfully when they do not produce an external effect. In this context, the movement itself may be seen as the goal. The aim of this study was to investigate how varying the type and number of goals affects imitative fidelity in 2- to 5-year-old children. In Experiment 1 children were shown two actions, of which the first action either produced an external effect (external-effect goal condition) or not (movement-based goal condition). In both conditions, the second action always produced an independent external effect. Action sequences either involved an external object (object-actions) or body movements only (body-actions). It was found that children in both age groups, 2- to 3-year-olds and 4- to 5-year-olds, imitated more faithfully in the movement-based goal condition than in the external-effect based goal condition for object-action tasks. For the body-action tasks, this was only significant for the younger age group. Overall, imitative fidelity was higher for object-actions than body-actions and for older children than younger children. In Experiment 2 the number of actions was reduced to one, either producing an external effect or not. The results revealed that there was no significant difference in action style imitation between Experiment 1 and 2 for either age group. These results support the theory that exact imitation is led by the inference of movement-based goals.

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**PB-021**

**More Than Just Relations: Exploring New Factors Underlying Success on Relational Match to Sample**

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Relational Match to Sample (RMTS) is a common test of relational reasoning involving matching one of two sample cards to a target card based on the relations “same” and “different”. Multiple studies have found animals unable to succeed on RMTS without language training or thousands of trials of corrective feedback. Children below the age of five also fail RMTS, even with feedback. Some (e.g. Penn, Holyoak & Povinelli, 2008) interpret such findings as showing that only language-proficient humans have a capacity for representing abstract relations.

In contrast to these findings, a recent series of studies (Smirnova et al., 2015; Obozova et al., 2015), demonstrated success on RMTS without feedback in crows and parrots. This was achieved by pre-training the birds with a series of non-relational match-to-sample tasks.

Adapting the Smirnova et al. paradigm, we trained four-year-olds on eight trials of a featural match-to-sample task, then tested on two versions of RMTS. Given this minimal pre-training, children achieved robust success on both versions without feedback, a year earlier than success on RMTS with feedback but no pre-training.

The result that children (and birds) are able to perceive and process the relational comparisons required for RMTS after minimal pre-training demonstrates that the task taps more than the capacity to process relations per se. The current work thus begins to explore aspects of cognition, over and above the capacity to process relations, on which successful instances of relational reasoning depend.

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**PB-022**

**Children succeed in True Belief if Failure is Costly**

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**Background**

The standard picture of explicit theory of mind (ToM) development is that children acquire a full blown metarepresentational understanding of beliefs around age 4 when they competently ascribe false beliefs to themselves and others. However, this assumption has been attacked by recent studies showing that once children start to succeed in false belief (FB) tasks, they also begin to fail in tasks requiring the ascription of a true belief (TB) to an agent. In these studies only older children seem to have real belief ascription competence. One question raised by these findings is, whether children’s failure in TB tasks is the result of a genuine lack of competence or more likely a performance problem. To investigate this we designed a study where failure is costly. If children’s poor performance in TB task is caused by a real competence deficit, they should still fail, while they should be able to master TB tasks/succeed, if it is a performance problem.

**Method**

We tested 36 children in a “sticker contest” (data collection still going on) where to win a sticker the child had to correctly infer the location of the sticker based on the hint given by a protagonist who had a FB or a TB.

**Result and Discussion**

In contrast to former studies children did not show a u-shaped TB performance. Moreover FB und TB performances were highly correlated. This clearly speaks for a performance based explanation of the classic pattern.

**PB-023**

**Dogs Identify Agents in Third-Party Interactions on the Basis of the Observed Degree of Contingency**

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To investigate whether dogs could recognize contingent reactivity as a marker of agents' interaction, we performed an experiment in which dogs were presented with third-party contingent events. In the perfect-contingency condition, dogs were shown an unfamiliar self-propelled agent (SPA) that performed actions corresponding to audio clips of verbal commands played by a computer. In the high-but-imperfect-contingency condition, the SPA responded to the verbal commands on only two thirds of the trials; in the low-contingency condition, the SPA responded to the commands on only one third of the trials. In the test phase, the SPA approached one of two tennis balls, and then the dog was allowed to choose one of the balls. The proportion of trials on which a dog chose the object indicated by the SPA increased with the degree of contingency: Dogs chose the target object significantly above chance level only in the perfect-contingency condition. This finding suggests that dogs may use the degree of temporal contingency observed in third-party interactions as a cue to identify agents.

**PB-024**

**Understanding commitment. Early or late development?**

Margherita Isella

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Studies from the late '80s have shown that children until around nine have several limitations in understanding the norms of commitment (Astington, 1988; Mant & Perner, 1988) – I will refer to these studies as “Late Development studies” based on their claim that commitment understanding develops late. However, more recent studies (henceforth “Early Development studies”) have provided evidence that even three-year-olds understand commitment (Gräfenhain et al., 2009; Kanngiesser, Köymen & Tomasello, in preparation). I show that while the findings of these two groups of studies may seem inconsistent with each other, in fact they are not, as they have focused on different aspects of commitment understanding, which have different levels of complexity. In particular, while in the Early Development studies children had to distinguish between norms of commissive speech acts

and other social norms (e.g., fairness norms), in the Late Development studies children had to distinguish between norms of commissive speech acts and norms of assertive speech acts (e.g., statements of intention). The aspect of commitment understanding investigated by the Late Development studies is more complex, and therefore it is not surprising that they have found it to emerge relatively late in development. Specifically, both commissive and assertive speech acts create expectations intentionally and explicitly, which makes it hard to distinguish their normative implications.

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**PB-025**

**Children's performance in a win-stay lose-shift discrimination task: Developmental trends in the relative efficacy of social demonstrations versus individual exploration**

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Many human cultural traits could likely only have arisen as an outcome of repeated episodes of social learning. In contrast, examples of cumulative culture such as this appear to be extremely rare in other species. It is possible that the distinctiveness of human culture could be explained by fundamental differences in how we learn from others, such as the degree of reliance placed on social information over individual experience. In the current study we aimed to elucidate developmental trends relating to this. The results will also be compared with nonhuman performance, as data collection using an analogous task is currently under way with squirrel monkeys.

162 children aged 1-5 completed a win-stay lose-shift (WSLS) discrimination task on a touchscreen tablet, beginning with a binary discrimination and followed by a three-way discrimination transfer test. We evaluated the effects of age, information source (social/individual), and type of information trial (win/lose) on task success.

Children of all age groups were able to acquire a WSLS strategy, and performance improved with age. An age-information source interaction indicated that older children applied a WSLS strategy more in the individual exploration condition than the social demonstration condition. Use of a WSLS strategy was greater after “lose” information trials than “win” information trials.

In addition to making comparisons with nonhuman primates, future research will extend this study to compare performance across cultures to investigate the extent to which children's use of socially- and individually- acquired information might itself be culturally dependent.

**PB-027**

**Young children’s understanding of the dissolvability of joint commitments**

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Children begin to participate in collaborative activities in the second year of life. Already then, they try to reengage a defecting partner to a joint goal (Warneken et al., 2006). At age three, children begin to understand the obligations of a joint commitment (Hamann et al., 2012), and tend to take leave when disengaging from a joint task if they previously had made a joint commitment (Gräfenhain et al., 2009).

In the current study, we ask whether children understand the dissolvability of joint commitments. Specifically, we explore whether their reaction to a partner’s disengagement from a joint task depends on how the partner dissolves the commitment. If children understand joint commitments as a binding obligation, they should accept a partner’s disengagement if the commitment is properly and jointly dissolved and resent it if the partner just leaves the task or does not dissolve the commitment appropriately.

We present 3.5- and 5.5-year-old children (data collection ongoing) and a puppet partner with a collaborative task that they agree to work on together. In three conditions we manipulate how the puppet disengages from the joint commitment. In the Dissolved condition, the puppet states a reason why she has to go and asks the child’s permission to leave. In the Take-leave condition, the puppet only states the reason and then leaves. In the Just-leave condition, the puppet leaves the room without saying anything. We observe children’s reactions to the partner’s disengagement, measuring their protest, tattling, trust in the puppet and sharing of resources.

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**PB-028**

**Before and After with Temporal and Spatial Meaning in Language Acquisition**

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Do Hungarian spatial postpositions have primacy with respect to temporal postpositions during language acquisition?(as in English: Bowerman, 1983) I observed the usage of spatial postpositions like before/in front of, after/behind also in temporal meaning.



The order of the acquisition of Hungarian locations is 'before/in front of' > 'behind' – because of the phenomenon called expediency (Pléh, 2014). In temporal relations, the order 'after' > 'before' can be predicted from the notion of order-of-events (Sellar, 1999).

The experiment had two subparts. The first part was a spatial task, where animals played hide-and-seek in a toy-room, and a puppet made statements about the location of the hider. The children had to judge the statement (Truth-value judgment). The second part was a temporal task, where children's task was to relate events to each other from a video (Forced choice). (n=30, age= 3;6 – 7;5)

There was no significant difference in the rate of correct answers between age-groups in the spatial task, but there was in the temporal task. Age had a significant effect on the production of 'before' in temporal meaning. The children tend to replace it with 'after'.

The acquisition of spatial meaning of these postpositions is completed by the age 4, but the temporal meaning is not completely acquired yet. Hence, spatial representation precedes the temporal one. The fact that the temporal 'after' had a higher correctness rate than 'before' indicates that expediency might have a role in the development of the temporal concepts as well.

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**PB-029**

**Children's Norm Enforcement Behavior and its Temperamental Correlates**

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By 3 years of age, children tattle about third-party norm transgressors, arguably in order to enforce cooperative norms (e.g., Vaish, Missana, & Tomasello, 2011). However, since the victim in prior work was absent during the transgression and so did not know who caused the harm, an alternative possibility is that children were worried that the victim would blame them and so felt the need to inform the victim about who caused the harm. To tease these possibilities apart, we devised a situation in which children knew that they could not be blamed for the transgressions caused by an actor. Nonetheless, 3-year-old children tattled on the transgressor more when the transgressor had caused harm than caused no harm (n=16 per condition;  $X^2(1, N=32)=9.31, p=.002$ ), indicating that children tattle to enforce norms rather than to avoid being blamed for the transgression.

Furthermore, no prior work has examined individual variation in children's tendency to enforce norms. As a first step in this direction, we asked parents to complete the Very Short Form of CBQ (Putnam & Rothbart, 2006). Focusing on the three subscales of Surgency/ Extraversion (Shyness, Impulsivity, and Inhibitory Control), we found that children's shyness (how slow or inhibited children are to approach novel or uncertain situations)

correlated negatively with their protest and tattling behavior ( $r=.33, p=.030$ ;  $r=.38, p=.014$ , respectively), whereas their impulsivity and inhibitory control did not correlate with either behavior. Thus, temperamental shyness seems to underlie some of the individual variation in children’s tendency to intervene in norm transgressions.

**PB-030**

**The role of mediation and source monitoring in decreasing suggestibility**

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The parental presence and the reminiscing style used by the parent in the memorial conversation helps the child in the memory accuracy of the event (Thompson, Clarke-Stewart and Lepore, 1999, Klemfuss, Rush and Quas, 2016).

In our experiment we aimed to study suggestibility with the connection between parental mediation and the method of the interview technique in the light of the maturing source monitoring and theory of mind. The participants were 7 year old children who watched a short video with or without their caregivers. In the test phase children’s memory were tested with various methods – free recall, open-ended and closed-ended questions, source memory - in a random order assuming that the order of the retrieval tests will have an effect on the succesful retrieval and the level of suggestibility. Children were also tested on theory of mind and source monitoring ability, because several studies found relationship between the level of the maturation of these cognitive functions and the ability of the resistance of suggestibility.

The results – connection between the active presence of the caregiver while watching the video and the order of the retrieval tests in the context of the maturing source monitoring and mentalizing abilities – highlight the importance of the active, elaborative presence of the parents as mediators in the forming and retrieval of the experienced events.

**PB-031**

**Previously shared information impacts performance in explicit false-belief task**

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This paper addresses the factors affecting performance on explicit false-belief tasks. Our proposal builds on the idea that mention of the target object creates unwanted attention on the object in the reality location [1-2]. We propose that mention of the target object typically

brings attention to the reality location via memory-based processes that are biased to retrieve previous \*shared\* information. We build on psycholinguistic research showing that information from previous shared interactions with an interlocutor becomes highly salient when cued at subsequent interactions [3-4, 5].

Our study is based on [1], experiment 2b. We manipulate whether the child shares the reality location with the experimenter who asks 'Where will the elephant look for the carrots'. For the experimental group (Age: 3.0-4.17; M = 3.61) we switch in a second experimenter after the object is moved. The control group (Age: 3.0-4.25; M = 3.66) procedure is as in experiment 2b in [1]. Participants also undertook a 'bear/dragon' IC task. In the control group, 6/19 children (32%) passed, similar to rates in [1]/expt. 2b. In the experimental group, 12/19 (63%) passed. A logistic regression analysis with condition, IC score and age as predictors revealed that only condition significantly predicted performance ( $p = 0.043$ ). Thus target mention impacts performance significantly more when the reality location is shared.

[1-2] Rubio-Fernandez & Geurts (2013), Psych. Sc.; (forthcoming) Rev. Phil & Psych.; [3] Horton & Gerrig (2005). Cognition; [4] Brown-Schmidt et al. (2015). Psych. of Learning & Motivation; [5] Moll & Tomasello (2007). Dev. Psychology.

**PB-032**

**White matter changes in the developing brain in response to language training**

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Language in humans develops on a protracted scale. Although most children start uttering words before their first birthday, they will not be expert language users for many years. During this time, the brain is also maturing and changing, especially in networks associated with higher cognitive functions, including the language network. We set out to explore the relationship between learning during this period of language acquisition and structural brain changes. The current study investigated white matter changes after a three week language training in 4-year-old children. During the training period, children learned 60 novel fictional characters and their labels in eight training sessions that lasted 10 minutes each. Each participant completed a maximum of three sessions per week. We acquired structural MRI, including diffusion weighted images, before and after the training. The children excelled at the lexical learning task, the group reaching above chance performance in the second training session. To examine white matter changes, we conducted a whole brain tract-based spatial statistics (TBSS) analysis in which we correlated FA change between pre-

and postscan with the change in behavioral accuracy on the novel items in a forced choice naming task in the beginning and at the end of the training. We found a correlation between white matter change and training performance in the left inferior frontal gyrus (Broca's area). Overall, children mastered the training task, and here we show that this language training outcome is related to white matter changes during the three week time period.

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**PB-033**

**Advice-taking in 4 to 6 Year old Children**

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Children are born into a complex world. To become effective social agents they have to acquire extensive knowledge, most of it by testimony of others. But not all information is of the same quality and worth considering to the same extent. Developmental research on selective trust has shown that children acknowledge this fact and learn new information selectively (Harries & Corriveau, 2011). But little is known on how children revise their existing beliefs, which is more complex than accepting knowledge to acquire a new belief.

In the current study we adapted for children a method used by social psychologist, the "judge-advisor system" (JAS; Snizek & Buckley, 1995). In a JAS, a judge makes an initial judgment in a decision task, receives advice from an advisor and then makes a final judgment. We presented 4- to 6-year-olds (n=43) with a visual perception task differing in difficulty depending on whether one had good or poor visual access. There were three conditions: 1 the child was better informed, 2 the advisor was better informed and 3 both were equally poorly informed.

Results revealed that children's advice taking is rational in the sense of being sensitive to their own epistemic situation (the better the child's visual access, the less advice is being taken). But this rationality is limited by the insensitivity to the advisor's epistemic situation (children did not differentiate between well and poorly informed advisors). Whether this reflects metacognitive or source monitoring limitations, for example, is currently being investigated in follow-up studies.

**PB-034**

**Reaching low for more: spontaneous mapping of stimulus size to space in long-tailed macaques (*Macaca fascicularis*)**

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Embodiment theories suggest that amodal concepts are grounded in sensorimotor contingencies and offer an explanation for spontaneous mapping of abstract concepts and quantities to space (e.g., humans adults, chimpanzees: higher position~more power; chicken, rhesus macaques, chimpanzees, preverbal human infants: right position~higher quantities). So far, it has been suggested that 'more' is associated with an upper spatial position. We tested an alternative, ecologically driven hypothesis for quantity~space associations: larger quantities are heavier and should, therefore, be expected on a lower position. We trained 12 long-tailed macaques to touch either the larger or smaller of two horizontally arranged stimuli on a touch screen. Those subjects who had to touch the small stimulus needed more trials to learn the task (mdLarge=384, mdSmall=672), indicating a natural preference to go for the larger stimulus. Subsequently, subjects had to choose between two vertically arranged stimuli of different size (large and small) or two stimuli of the same (medium) size. The 'small group' outperformed the 'large group' in different size trials (msmall=74%, mlarge=60%) and the large group expressed a clear preference for the lower position, in same size trials (mDown=80%). It seems that in the absence of perceptual cues, individuals who looked for larger stimuli preferentially associated them with the lower position. While the transfer to the vertical task had no performance consequences for the small group, the large group's performance was clearly affected by the new spatial arrangement. Overall, we interpret these results as support for the weight hypothesis.

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**PB-035**

**Results of longitudinal assessments of extremely low birth weight newborns**

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Aims of the study: Premature birth involves developmental risks, the earlier the baby is born and the lower its birth weight the higher the risks. The developmental outcome of immature, low birth weight infants is hard to predict. Our aim is to identify the factors influencing the

infant and preschool-age development in extremely low birth weight preterms.

Method: Sixty-seven ELWB (less than 1000 gram) children participated in our longitudinal study. The psychomotor development of the infants was assessed using the Brunet-Lèzine Developmental Scale at the corrected ages of 1 and 2 years, then at 5 years the children were tested with the OWI-HAWIVA IQ test. Birth weight, gestational age, perinatal complications, gender and maternal education were entered in the data analysis as independent variables.

Results: Our subjects as a group scored in the average range in each subscale of the Brunet-Lèzine Developmental Scale; the changes in the scores as the infants grew older suggested a catch-up tendency. At 5 years the children scored lower on the non-verbal subscale (PQ) as compared to the verbal subscale (VQ). In infancy the most powerful factors explaining the individual variations in the developmental outcome were birth weight and gender (with the males lagging behind). By 5 years the handicap of the boys disappeared. Infant psychomotor scores predicted the 5-year IQs at the group level. However, considerable changes occurred in the rate of development in individuals.

**PB-036**

**Visuo-spatial orienting triggered by biological motion walking direction: ERP evidence from 6-month-old infants**

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The ability to detect social signals in the environment represents a first step to enter our social world. Behavioral evidence has demonstrated that 6 month-old infants are able to orient their attention towards the position indicated by the walking direction of a biological agent, showing more efficient orienting responses towards stimuli cued by the direction of motion than towards uncued stimuli.

The present study investigated the neural mechanism underpinning this priming effect by using a spatial cueing paradigm and recording EEG from 6-month-old infants. Infants were presented with a point-light walker displayed at the center of a monitor and randomly facing to the left or to the right. This stimulus was the spatially non-predictive cue, followed by a single peripheral target randomly appearing at a peripheral position either congruent or incongruent with the walking direction of the cue. We examined infants' ERP responses to target stimuli and coded saccadic eye movements towards targets by using an offline coding procedure.

Results revealed that the P100 ERP component as well as saccade latencies towards

the peripheral target were modulated by the congruency between the walking direction of the cue and the position of the target. Specifically, the P100 ERP component was larger in response to congruent targets than to incongruent targets.

Overall, these findings suggest that biological motion walking direction can trigger covert orienting of attention, enabling a sensory facilitation in processing potentially relevant information and a facilitation of oculomotor responses to stimuli appearing at the attended location.

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**PB-037**

**Mechanisms underlying arrow comprehension in four-month-old infants**

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Infants in the first months of life start to learn associating abstract auditory cues (words) to various concepts and actions. We asked if an abstract visual icon such as an arrow can naturally induce a measurable change in behavior. We showed that a one second exposure to an arrow icon, without any training, can make a sustained reorientation of attention in 4-month-old infants for several seconds after its disappearance. We further modified the different features of this icon to investigate the possible mechanisms that induce this effect.

We showed that a triangle alone can induce a similar effect in the same age-range. Finally we tried to investigate the differences in the temporal gaze distribution over the icons, in the correct versus incorrect trials in order to understand whether this is merely a bottom up process or there is also a top-down proto-symbolic effect involved.

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**PB-038**

**Children create the core properties of language: Evidence for modality compensation in young children's gestural responses to motion events.**

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All of the world's languages share a number of universal properties or design features; this includes breaking down information into discrete units and recombining them into linear sequences. For example, the manner and path of a motion event are segmented into smaller semantic units and re-organised into linear sequences (e.g. 'bounce down'). Previously we showed that, in a task that involved using silent gestures to express motion events, typically-developing children spontaneously bring the core linguistic properties of segmentation and

linearisation into their communication systems, whereas adolescents or adults do not. Here, we extended these findings to investigate which proximate factors might relate to these tendencies to reshape communication into language-like forms. We examined whether the tendency of 4, 5, and 6-year old children to gesturally segment and linearise information to express motion events varied in relation to measures of their working memory, linguistic development (measured using receptive vocabulary scores) and motor control. Results showed that the tendency to segment and linearise information declines steadily with age, with 6-year olds showing mostly adult-like patterns. Gestural segmentation was unrelated to measures of working memory and motor control, however children with poorer receptive vocabulary were significantly more likely to show segmentation. Our results suggest that even in the absence of a profound hearing impairment, as for deaf children, children may possess intrinsic strategies to support their own linguistic development. Children with poor linguistic development in the spoken modality may be able to compensate by showing more linguistic readiness in the gestural domain.

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**PB-039**

**Five-year-old children show adult-like feedback error-related negativity under parental support**

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Prior studies have suggested that brain feedback processing, reflected in feedback error-related negativity (fERN) is underdeveloped in five-year-old children, which could be explained as resulting from underdeveloped brain structures and functions. However, children show adult-like fERN during attentive tasks conducted in supportive environments. This ERP study that focused on parental support was designed to experimentally demonstrate feedback processing in five-year-old children. The children conducted a “find an animal task”, which was similar to a visual search task, either with parents (supportive condition), or alone (alone condition). Children were requested to search for a cute animal image designed to maintain attention that was randomly presented on the left or right side of the screen together with other animals, and respond by using a left or right response button. The response time limit was determined for each child based on his or her performance to maintain equal correct and incorrect feedback rates. Children received “correct” feedback ( ) if they responded correctly within the time limit, or “incorrect” feedback (×) if they responded incorrectly, or accurately, but outside the time limit. We found adult-like fERN in children in the supportive condition, but not in the alone condition. This is the first demonstration of fERN in five-year-old children to our knowledge. These findings suggest that parental support is a major factor in developing feedback processing in the developing brain.



**PB-040**

**Status and friendship affect prosocial behaviour in 6–9-year-old children**

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Humans frequently help nonrelatives and they do so even in cases where interactions are unobserved and unlikely to be repeated. This so-called prosocial behaviour seems to be developed fully by the age of 6 years. However, questions about which factors modify prosocial behaviour at that age remain understudied. Here we used a resource allocation paradigm to test prosocial behaviour in 6–9-year-old primary school children in Austria. Children could allocate a valuable resource (i.e. stickers) to themselves and to a same-gender receiver from their class. They had to decide between a selfish option (i.e. one sticker for themselves) and a prosocial option (i.e. one sticker for themselves and one for the receiver). In order to prevent potential experimenter cueing, we used an apparatus that barely needed instructions. We tested whether friendship, status and prenatal androgen exposure (approximated by 2nd to 4th digit ratio; 2D:4D ratio) had an influence on prosocial behaviour. We found a negative effect of within-class status on prosocial behaviour: i.e. children that had fewer interaction partners in their class showed more prosocial behaviour during the test. Friendship had a small positive effect on prosocial choices: children paired with friends tended to choose the prosocial option more often than children paired with non-friends. We found no direct effect of 2D:4D on prosocial behaviour, but low levels of the approximated prenatal androgen exposure were correlated with a higher number of within-class interaction partners in girls. Our results point to an early effect of status and friendship on prosocial behaviour.

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**PB-041**

**Japanese and German perschoolers' metacognition**

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Recent studies have begun to demonstrate the presence of implicit or experience-based metacognition in young children. However, no studies investigated cross-cultural variation of metacognition. In the present research we tested 3- to 5-year-old Japanese and German children's experience-based metacognition by adopting the method of Hembacher and

Ghetti (2014). We found Japanese children were better than German children in both memory monitoring and control sensitivity. First, their uncertainty assessments about their own memory on a graded scale better corresponded to their memory accuracy than their German counterparts. Second, although both cultural groups seemed equivalent in sorting out for later evaluation the items they felt more confident about, only Japanese children's sorting decisions further corresponded to their memory accuracy. The findings may suggest that Japanese children are better able to allocate their attention to contextual information (e.g., sensitivity to a reward based task).

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**PB-042**

**Desires before beliefs - Comparing 3-year-olds' understanding of incompatible desires, competitive games and false beliefs**

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One long-standing dispute in theory of mind research concerns the development of understanding different kinds of propositional attitudes. Do children acquire an understanding of conative attitudes such as desires before an understanding of cognitive attitudes such as beliefs (Wellman, 1990)? Or does a notion of subjective attitudes proper, both cognitive and conative ones, develop simultaneously (Perner, 2004)? Empirically, support for the former claim comes from tasks investigating children's verbal ascriptions of mutually incompatible desires (Rakoczy et al., 2007), while the latter is supported by research on children's actions in competitive games (Priewasser et al., 2013). The current study aims at resolving this tension by combining the different forms of measurements in a simplified design. Children play a game against a puppet, where the first to cross the finish line receives a desired sticker. Between subjects we manipulate the dice to resemble the pay-off of either an incompatible desire task (Option1: A moves, Option2: B moves) or a competition task (Option1: A moves, Option2: A and B move). We test for both children's verbal ascriptions of desires and desire-dependent emotions as well as their poaching moves. Additionally, we assess children's false-belief understanding. Preliminary results imply that children are better at ascribing desires than at ascribing beliefs for both incompatible desire and competition tasks. Furthermore, their active poaching moves seem to resemble their desire ascriptions. Though data collection is still ongoing, the results so far favor the asymmetric development of conative before cognitive propositional attitudes.

**PB-043**

**“Where will I go first?” Children’s future thinking abilities in a two-step spoon task**

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One of the most commonly used methods to investigate the development of future thinking is the “spoon test” (Tulving, 2005). This task typically involves children selecting an item (e.g., key) in a first room that then allows them to secure a future need (e.g., obtain stickers) in a second room. It has been argued that since the “spoon test” does not directly assess “temporal reasoning” (i.e., ability to reason about before-and-after relationships between different events in time), it is unclear the extent to which foresight is required in this type of task. In the current study, 3-, 4- and 5-year-olds were presented with a two-step “spoon test” in which to secure a future need (e.g., play with a marble run game), children first had to obtain a “key” that allowed them next to access the “marbles.” Planning (i.e., item choice), and temporal reasoning were assessed. By the age of 4 children selected the correct item and by the age of 5 children successfully selected the correct item and correctly indicated the order in which to visit the rooms. Moreover age and temporal reasoning explained age-related changes in children’s planning abilities. The present findings suggest that “temporal reasoning” is a crucial aspect of future thinking and should thus be assessed in future thinking tasks.

**PC-040**

**Description of the mental status in the narrrtives of children with and without SLI**

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The ability to comprehend yourself mentality and the status of others refers to the field of human mental development called "model of mentality," or theory of mind. The verbal expressing of the mental status can be categorized according to the aspects of "the mental life": description of perception (see, hear); description of the physiological conditions (to be hungry, feel pain); emotions description (sad, happy); mental processes such as desire, intention, opinion description (to want, to think, to know); description of the acts of speech (say, to call it).rnThe aim of my study is to investigate how the children describe the mental status of the characters

in the narratives, as well as to identify differences between the children with typical speech development and children with specific language impairment (SLI). Material: 40 narratives by monolingual Russian children age 4.5-5.5 with and without SLI. Children were examined with the “theory of mind” test. All of the informants were successful in the understanding the mental causation in behavior of others, as well as the emotions caused by the desire or situation. In spite of this the children telling the story are focused on the processes of perception, physiological and mental status of the characters only. In the narratives of children with SLI was the description of speech interactions between the characters hardly ever fixed; physiological and emotional status mentioned much less frequently than typical kids. The active vocabulary also was smaller in the SLI group.



POSTER  
SESSION C

**PC-001**

**The Importance of Intentionality for Bilingual Proficiency**

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Not much is known to what extent children's own engagement in early interactions shapes their developing proficiency in two languages. The purpose of this study is to show that intentionality is the main predictor of bilingual proficiency. Bloom and Tinker's (2001) Intentionality Model is taken as conceptual framework and applied to the development of bilingual skills, i.e., the need to produce two languages or not.

The subject for this study is Julia, born in Sweden to her Russian mother and Swedish father. This study reports on Julia's linguistic development in the second year of life. It is hypothesized that the child learns to use her languages according to the patterns and feedback signals that she finds in the input. The main focus is on Julia's caregivers' patterns of language use and Julia's responses to their reactions. A total of 1200 utterances have been analyzed and the interactions that involve repair sequences were compared to those that do not.

The results show that Julia learns her two languages through her capacity to interpret the interactions with her caregivers and through her desire to make herself understood. Her linguistic production is the result of the dynamic interaction she is engaged in. The ways that others respond to the child are crucial for her bilingual development. The results from this study show how important children's motivation is in determining whether they will speak two languages or not.

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**PC-002**

**Referential action interpretation supports word-mapping in 12-month-olds**

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Infants' abilities to understand observed behaviors was suggested to be underpinned by two distinct action interpretation systems: teleological (instrumental) and referential (Csibra, 2003). The first system highlights the goals pursued by an agent, whereas the second singles out those aspects of the world that are being communicated about. Which of the two systems is activated by an observed action depends on the availability of certain cues (e.g., particular motion patterns, eye gaze, speech, etc.) and on the familiarity with the action type. We hypothesized that as soon as infants become familiar with prototypical referential and instrumental actions, such as pointing and grasping, the observation of these actions could selectively satisfy the criteria of application of the referential and instrumental action interpretation systems, respectively. To investigate this hypothesis, we

tested how 12-month-olds map novel words onto objects targeted either by pointing or grasping. Infants participated in a word-mapping task, in which one of two objects on the stage was first targeted by a gesture (pointing or grasping) and then labeled. We found that infants associated the words with the target objects when the labeling followed pointing actions, but failed to do so when it followed grasping actions, suggesting that only pointing was interpreted as referential and led to the conceptualization of the object targeted by this action as the likely referent of a concurrently uttered novel label. In a follow-up study we demonstrated that grasping actions that are presented in a communicative context (i.e., grasping is preceded by infant-directed speech) are also interpreted as referential and support word mapping, indicating that action interpretation is flexible and can be modulated by the presence of communicative signals.

**PC-003**

**How linguistic experience shapes categorization: a study on bilingual and monolingual infants**

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In order to find the referents of words, infants rely on constrains that guide their interpretations. Currently, little is know about how language experience influences referent identification in word acquisition. Comparisons between bilinguals and monolinguals can be particularly revealing. Overall, it is known that bilinguals achieve most linguistic milestones around the same ages as monolinguals, despite the need to learn from noisier input. However, their strategy for referent identification may be quite different. We explored this question by studying how bilinguals and monolinguals acquire words for categories at different ages. Specifically, we asked wether bilinguals' early advantage in executive function tasks, together with the need to learn in noisier contexts, may translate into different categorization abilities. We tested 8, 15 and 19-months-old infants with an anticipatory eye movement procedure introduced by Saksida (2014) here adapted to test category learning. Participants were assessed on their ability to fast-map a novel label to a reference category both directly and by mutual exclusivity.

We found that at 8 and 19 months bilinguals learned category referents better than monolinguals, although with different temporal profiles at different ages. We also found that at 19 months bilinguals applied mutual exclusivity. These results suggest a much more complex picture of the influence of linguistic experience on referent identification than currently acknowledged.

**PC-004**

**The role of the insula in mathematical problem solving in children**

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Numbers are an important part of development. Psychologists have tried to understand the cognitive mechanisms that underlie mathematical performance. Often these are linked to improvements of working memory and the development of the prefrontal cortex. In adults, for instance, we know that mathematical operations activate the prefrontal cortex more extensively compared to basic number processes such as quantity discrimination. More functional magnetic resonance imaging (fMRI) studies are accumulating in recent years, however, a clear understanding of the brain areas that underlie mathematical processes in children is still lacking. We systematically search the literature and identified eligible fMRI studies that examined mathematical problem solving in children, and selected contrast coordinates based on whether the task was related to (a) number tasks -numerical processing without having prescribed operations such quantity discrimination and (b) calculation tasks - formal mathematical operations such as addition and multiplication. Activation Likelihood Estimate (ALE), a quantitative meta-analytic method was used to generate 3D maps indicating the likelihood of activation within a given voxel of a template brain. We report data on more than 300 children under the age of 12, who solved number and calculation tasks. Although key areas for number tasks were found in parietal cortices, solving the areas with the highest likelihood of being detected in children was the insular cortex bilaterally. Insular involvement may suggest a reliance on a salience network when children solve mathematical operations.

**PC-005**

**Electrophysiological correlates of chained mental operations in 5-month-old infants**

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In order to progress through the hierarchy until the more abstract representations postulated in language, one needs to integrate various features – abstract or not – of the input, and recode it into a single mental variable that is then available for further computations. We can then



chain multiple complex operations. This mental ability allowed the development of the rich symbolic systems we constantly use to represent the various aspects of the external world. In two experiments, we asked whether 5 month-old infants could recode an abstract structure into a mental variable that could be used as input for a second computation. More specifically, we designed a paradigm in which infants had to extract and categorize trisyllabic nonce words according to their structure in order to associate each abstract pattern to an arbitrary label. After a brief exposure to the abstract patterns consistently followed by their associated arbitrary labels, we test infants' learning performances by introducing some incongruent associations. Using electroencephalography, we were able to evidence congruency effects. These results extend previous findings on abstract learning, and demonstrate that young infants can form abstract representations of speech structures reliable enough to be associated with an arbitrary label. The encoded abstract representations therefore appear to possess the required attributed to enter a symbolic system.

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**PC-006**

**Engaging in joint attention at 9-months depends on infant response type to maternal bids**

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Joint attention (JA) emerging at around 9 months of age refers to a triadic interaction when the caregiver and the infant manipulate an object with alternated gaze shifts. Studies showed that eye contact elicits subsequent gaze following, and that repeated gaze shifts facilitate the encoding of gaze-object relations in infants. The present study examined maternal and infant initiations and responses (including gaze direction) in relation to dyadic engagement in object manipulation (including JA and parallel JA). Ten-minute toy play sessions of 40 mothers and their 9-months-old infants were evaluated by using micro-analytic behavior recording. Relative duration of parallel JA, when the infant attended maternal object manipulation, moderately correlated with the frequency of the mother's entertaining initiations (labeled as animation) and with initiations accompanied by looking at the infant's face. Furthermore, the occurrence of JA was related to the amount of parallel JA, maternal initiations accompanied by looking at the infant, the infant's partner-oriented responses to bids, and the infant's initiations. Logistic regressions revealed that the infant's partner-oriented response (i.e. both shifting gaze and starting to engage with the object as a response to maternal bid) was the only predictor of JA. Our results suggest that, while maternal behavior plays a significant role in maintaining the infant's parallel JA, this

engagement does not necessarily contributes to JA state. Rather, one might speculate that the infant's developing ability of shifting attention between the object and the partner could play a crucial role in establishing JA in mother-infant pairs.

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**PC-007**

**How speech-action relatedness influences 24-month-olds' selective imitation**

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Meltzoff (1995) showed that, by 18months, infants can look past an adult's surface behavior, reproducing the adult's underlying intention, even if the corresponding action was never observed by them before. Furthermore, infants selectively imitate intentional over accidental actions (e.g., Olineck & Poulin-Dubois, 2005). We investigated if infants can process and, in their imitative behavior, rely on an adult's speech, even if that verbally announced action intention does not match the adult's following observable action.

Forty-six 24-month olds observed an adult performing one of two possible actions (e.g., up and down) on an object. First, the adult verbally announced that she wanted to perform an action(e.g., 'up'). In a between-subjects design, she then performed either the matching action (e.g., up; congruent condition) or the non-matching action (e.g., down; incongruent condition). Then, infants could act on the object themselves. This procedure was repeated across 2 more trials with different objects, actions, and prepositions.

As expected, infants in the congruent condition performed the demonstrated action more often than infants in the incongruent condition ( $p<.01$ ); infants in the incongruent condition performed the alternative action (matching the spoken intention) more often than infants in the congruent condition ( $p<.01$ ).

The two conditions only differed in the relatedness between speech and action, so we conclude that infants were able to perceive the discrepancy between the actor's verbal announcement and the performed action. This indicates that infants can process verbal communication in terms of action intentions and use this information to guide their imitative behavior.

**PC-008**

**Infants track individuals, and not just action roles, in interactions involving giving actions**

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We investigated whether infants conceptualize the actor who performs a giving action as a historically continuous individual rather than just an agent in a specific role in the interaction (i.e., a Giver). This is hypothesized because giving actions are costly and hence they should induce expectation for direct reciprocity, which implies tracking individuals. Using eye-tracking methods, 14.5-month-old infants were trained to map a novel word onto an agent of constant appearance and action role in an interaction, and then we tested which agent the trained word would be extended to in a new interaction. When the Giver was labeled during the training (Experiment 1), infants mapped the new word onto the Giver. This mapping of the word onto the actor was dependent on the specific interaction, as it was not observed when the actor discarded the resources rather than gave them to the Giver (Experiment 2). Experiment 3 confirmed that infants interpreted the trained word for the Giver as the name of this individual, since when the Giver and Giver swapped their roles, they mapped the trained word onto the agent with the same identity instead of onto the agent with the same action role (i.e., Giver). This result was replicated with actors without human-like facial features (Experiment 4). Taken together, these studies demonstrate that the type of interaction determines how infants conceptualize the participating agents: Chasing calls for tracking action roles (Yin & Csibra, 2015), giving calls for tracking historically continuous individuals.

**PC-009**

**Preschoolers Prefer Hierarchical Relationships to Non-Hierarchical Relationships**

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Navigating the social world requires ‘naïve sociology’—the ability to infer social relationships (Kaufman & Clement, 2014). From very early on, humans recognize, for example, hierarchical relationships—expecting larger agents and those with more allies to win dominance contests, and for hierarchical relationships to remain stable across situations (Mascaro & Csibra, 2012, 2014; Pun, Birch, & Baron, 2016; Thomsen, Frankenhuys, Ingold-Smith, &

Carey, 2011). But can children differentiate between two types of relationships? If so, do they prefer one type to another? We investigated this question by showing 3 to 5-year-old children videos featuring two pairs of puppets—a hierarchical pair, where one puppet is in charge, and a non-hierarchical pair where the puppets take turns being in charge. When asked, “Which ones do you like?” 50/72 children chose the hierarchical pair ( $p=.0013$ ); when asked, who they would rather build a tower with, 48/72 chose the hierarchical pair ( $p=.0186$ ), suggesting a preference for the hierarchical dyad. But could this preference simply reflect a preference for an easier to comprehend relationship, where one puppet always performs the same action? In Experiment 2, children saw modified videos, the actions were the same, but they were scrambled so that there was no ‘directing’. Preliminary results strongly suggest that in this case children have no preference (26/56 chose the easy-to-comprehend pair for the tower question ( $p=.6889$ ); 24/56 chose the easy-to-comprehend pair when asked who they like  $p=.350$ ). Taken together, these results suggest that 3-5 year olds differentiate between hierarchical and non-hierarchical relationships and prefer hierarchical relationships.

## PC-010

### Teaching in mathematics and science: A recategorization method to improve pupils’ cognitive flexibility

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Children have preconceptions on both scientific and mathematics concepts (Vosniadou et al., 2008, Fishbein, 1989). They intuitively rely on superficial features, triggering a wrong categorization of the situation (Chi, 2008). Hence taking into account preconceptions is key to studying conceptual difficulties that children meet in structure’s abstraction (Bassok et al., 1998) and in causal reasoning (Gopnik et al., 2004). In order to get over preconceptions and develop more relevant conceptions, we hypothesized that pupils have to form different representations of the same situation through a process of semantic recoding (Hofstadter & Sander, 2013) allowing reinterpretation of the situation and promoting cognitive flexibility.

This research developed a learning method in mathematics and in sciences that could improve cognitive flexibility measured through the degree of abstraction and transfer. The study was conducted with 8 classes (Year 3-4) from high-priority education schools in the Paris region following this protocol: pre-tests, 5 learning sessions for experimental and control groups, post-tests. During sessions, children studied dual-strategy distributive problems and inquiry reasoning (La main à la pate activities). Recategorization was used through contextualized sessions together with decontextualized tools (point of view’s tool

in mathematics, abstract inquiry-activities in science). The mathematical experimental group (N=66) significantly improved its flexibility (abstract strategy: +41%,  $F(1,1134)=8,3$ ;  $p<0,001$  and dual strategies: +34%,  $F(1,1134)= 6,95$ ;  $p<0.001$ ) and the science one (N=76) in its degree of transfer (protocol elaboration: +32%,  $F(1,140)= 9,429$ ;  $p=0.0026$ ). Therefore the teaching method seems to offer perspectives for improving cognitive flexibility, in both degrees of abstraction and transfer.

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### PC-011

## Enhanced Procedural Memory in Tourette Syndrome

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Procedural memory, which is rooted in the basal ganglia, underlies the learning and processing of implicit motor and cognitive skills. Procedural memory impairments have been found in both developmental and adult-onset disorders with basal ganglia abnormalities. However, brain abnormalities could in principle also lead to atypically enhanced function. Tourette syndrome (TS) is a candidate for enhanced procedural memory, given previous findings of enhanced TS processing of grammar, which may depend on procedural memory. The present studies investigated implicit probabilistic sequence learning (PSL), which depends on procedural memory, in TS. The first study assessed PSL in children with TS, ADHD, comorbid TS-ADHD, and typically developing (TD) children. All four groups showed evidence of sequence learning and did not differ from each other on measures of PSL. The second study compared PSL between larger samples of children with TS and TD children, who were tested in two sessions with a 16-hour delay between them. The children with TS showed better sequence learning than the TD children on both the first and second days, despite a regression of sequence knowledge overnight to the level of the children with TD. Overall, the results suggest that children with TS have normal or even enhanced procedural learning and retention. This is the first demonstration of enhanced procedural learning in any disorder.

**PC-012**

**What drives preschoolers' action imitation?  
An attempt to disentangle affiliative and normative motives**

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Humans can be surprisingly faithful in what we imitate from others, including actions that render an instrumental activity less efficient. But faithful imitation is not necessarily maladaptive, since imitation can serve different functions: an instrumental function for learning novel tasks and a social function to signal commitment to group-specific rules or a desire to affiliate with somebody. Several accounts have been suggested to explain and predict the occurrence of imitation based on social reasons. While affiliation accounts focus on the social motive to belong, be accepted or liked by others, normative accounts emphasize the role of the normative status of observed actions, e.g. conventional rules. Here, we attempt to disentangle affiliative and normative motives for imitation. We presented 4-5,5 year-olds with puppet models who had different individual preferences for doing things different or alike. The models performed actions either in a conventional or idiosyncratic manner. We assessed whether children chose same/different tool and same/different path when it was their turn, and whether they criticized another agent for acting the same as or different from the model. Preliminary analysis indicates that children copied both elements more often in conventional than idiosyncratic conditions (79% vs. 63%), but no effect for the individual preference manipulation. Third-party critique occurred mostly for violating conventional rules rather than ignoring the model's preference. This indicates that participants' behavior was mostly driven by the normative understanding of the actions rather than a desire to please the model or prevent her from being disappointed.

**PC-013**

**That's Not Fair! Prosocial Children Enforce Third-party Fairness Norms**

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The motivational source of the early sense of fairness remains a puzzle. Are normative expectations about third-party fairness interrelated with a concern for the welfare of others or do they largely build on routine behaviors, regularities, and habits that are orthogonal to children's prosociality? To address this question, we assessed very young 3-year-olds' third-party enforcement of fairness norms and interrelations between their norm enforcement and their own prosocial behavior as an indicator for a concern for the welfare of others.

In a within-participants design, children (N=20) were given a fairness task (adapted from Rakoczy et al., 2016), two prosocial tasks (adapted from Schmidt & Sommerville, 2011; Vaish et al., 2009), and a verbal IQ task (Kaufman & Kaufman, 2004). Preliminary results suggest that children's tendency to protest against unfairness as an unaffected bystander was interrelated with their own prosocial behavior controlling for verbal IQ (GLM,  $\chi^2(1)=12.39$ ,  $p<.001$ ): Children who showed prosocial behavior in both prosocial tasks performed most protest against unfair distributions (M=1.0, SD =.00), followed by children who only once showed prosocial behavior (M=.36, SD =.17) and children who did not show any prosocial behavior (M=.10, SD =.07).

These findings suggest that very young children's normative expectations about third-party fairness are closely interrelated with their own prosocial behavior. Thus, the ontogeny of fairness norms may be characterized as moral in that it is associated with children's developing concern for the welfare of others. More broadly, the current findings shed light on children's motivation for enforcing fairness norms more generally.

#### PC-014

### Discrimination between ingroup and outgroup human partners in dogs

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Social species has an evolutionary pre-wired capacity to identify the members of their groups which manifest itself through different mechanisms, including kin recognition, conspecific recognition and the sensitivity to familiarity. Until now, only a few studies have focused on the role familiarity and group belongingness may play in social categorization.

The purpose of the present study, therefore, was to examine the dogs' ability to differentiate between unfamiliar humans according to whether they show or do not show behavioural indicators of social strangeness (i.e. ingroupness/outgroupness). More specifically, we investigated that after having participated in interactions with two people behaving differently (like or unlike their owners), how dogs initiate social interactions and share their attention between the 'outgroup' and 'ingroup' potential helpers in an unsolvable problem situation. We predicted that if dogs are capable of inferring group membership based on prior social interactions with the potential helpers, they should show a preference for the 'ingroup' partner when interacting in order to 'ask for help'.

Twenty six adult (older than a year) pet dogs and their owners participated on the study.

Results clearly show that dogs can discriminate between potential helpers; they spend more time looking at, and gazed significantly more often at the ingroup than at the outgroup person demonstrating ingroup-outgroup bias.

**PC-015**

**Preschoolers can modulate their cognitive control : First evidence from proportion congruency effects**

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Control modulation is one of the hallmarks of efficient cognitive processing in adults. Control modulation might be critical in childhood considering that control processes are still partially immature, maintaining a high level of control being hence particularly costly. The manipulation of proportion congruency (PC) in conflict tasks has become a benchmark tool in the study of control modulation in adults: the PC effect corresponds to a decrease of the congruency effect when the proportion of incongruent trials increases (Abrahamse et al., 2013). The present study is the first to examine PC effects in kindergarteners and third graders.

Ninety-one 5-year-olds and eighty-two 8-years-olds were presented with a child-adapted version of the Stroop task: Fruits or vegetables with well-known prototypical color were displayed on a computer-screen either in their usual color (congruent trials) or in a different color (incongruent trials). Children were required to decide the true color of the stimuli while ignoring the color displayed on the screen. A mixed design was used allowing both within- and between-subjects analyses of PC effects. Children were distributed across three conditions involving two phases each: (1) a series of trials including mostly congruent trials followed by a series of mostly incongruent ones (MC-MI); (2) MI-MC and (3) a control condition including two similar series of 50% congruent trials. PC effects were obtained considering either intra- or inter-individual comparisons. Interestingly, these effects were not qualified by age.

Altogether, this study reveals aspects of control efficiency in young children that have been, as yet, largely under-investigated.

**PC-016**

**Children avoid “calculated” helpers based on third-party observation: The “peeking” experiment**

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In social situations where reputation is important, behaving cooperatively only when it enhances your reputation might be especially adaptive. However, in most human societies, such a strategy should be evaluated as “mean”, “hypocritical” or “calculated”, and collapse your reputation once it becomes in public. The present study approached the developmental origin of this kind of social judgement by examining how 4- to 5-year old children evaluate



such “calculated” agents. On the puppet stage, the participant (N=27) was shown 2 agents as follow: (1) “Public-only Helper,” who helped another puppet when it (knew it) was observed by the participant, but did not do so when it was not being observed (but in fact the participant was secretly peeking at the interaction). (2) “Private-only Helper,” who helped when it was not being observed by the participant but did not help when it was being observed. After observing both of the 2 types of interactions, the participants’ relative preference between the two helpers was measured. The results showed that the participants consistently preferred Private-only Helper compared to Public-only Helper. Further study on adults (N=40) showed the same preference as children, and the results of additional experimental condition suggested that Public-only Helper was even more negatively evaluated than Unconditional Non-Helper, who refused to help regardless the presence/absence of the observation by others. These evaluation biases, already present in 4-year-olds, might function as the counter strategy to prevent the “calculated” strategy from becoming optimal in human society.

### PC-017

## Does rear-search error in the mark test indicate a uniqueness of body-representation in young children?

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We reported here an interesting exploration error in normal developing children aged around 2-year-olds during body parts localization of mirrored self-body. A colourful sticker was covertly placed on children’s foreheads as a mark. Next, their face was presented in a mirror. As the many studies already indicated, most children are able to recognize mirrored self-image as a reflection of the current self because they could remove the mark from their real forehead (Gallup, 1970; Amsterdam, 1972). However, some of them initially attempted to remove the mark on the rear of their heads, even though it was placed on their forehead. We assumed that this “rear-search error” is related to underdevelopment of body parts representation.

First, to clarify the developmental occurrence of rear-search error, we tested how many children displayed rear-search error in forty-five 2- and 3-year-olds (Experiment 1). The rear-search error was observed in 36% of the 2-year-olds. Then, to clarify if rear-search error differed by body part, we tested twenty-four 2-year-olds when a mark being placed on children’s nose (Experiment 2). We found that no child initially attempted to search for the mark on the rear of his/her head. Therefore, it seems that rear-search error occurs when a mark is placed on a forehead rather than a nose. This result indicates that the difficulty of non-visible body-part mapping with a mirror image might differ according to body parts and a uniqueness of body-representation in 2-year-olds.

**PC-018**

**The development of Social Working Memory in preschoolers and its relationship with Theory of Mind**

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Recently, neural and behavior studies have proved that Social Working Memory (SWM) is independent from general cognitive working memory, and has a much closer relationship with social cognition. We believed this special relationship stemmed and developed from early childhood, and explored this in the current study. We investigated the development trajectory of SWM from 3 years old to 6 years old, with biological motion animation as stimulus and change detect paradigm as estimation method. To explore the relationship between SWM and social cognition in early childhood, we tested children's theory of mind (ToM) and calculated the correlation between SWM and ToM. Meanwhile, to examine whether this special relationship (if it exists) is generalized to dynamic stimulus or specialized to social information, we set a control group, in which the working memory of rectangle movement was tested. As a result, we found that children's SWM developed dramatically, especially between the 4th and the 5th year. More importantly, SWM capacity significantly correlated with ToM scores (even when age was controlled), while WM of rectangle movement did not. Our study further supports SWM's independence from general cognitive working memory, and highlights the important role of SWM in social ability development.

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**PC-019**

**Negation facilitates toddlers' updating of mental representations of absent objects**

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Prior research has shown that 23-month-olds struggle with verbal updating (Ganea & Harris, 2010; 2013). When shown a toy hidden in one place, and then hear that the location has been switched, 23-month olds often commit perseverative search errors. Ecker et al., (2010) has argued that it is the removal of information from WM that lies at the heart of updating. When given opportunity to first remove no-longer relevant information from working memory, adults were much faster in updating new information (Ecker et al., 2014). We tested whether facilitating the removal of no-longer relevant information helps 23-month-olds update knowledge about an unseen referent. We facilitated this process by either providing a negative statement (e.g., "The puppy is not in the same place anymore."), or by showing the toy being taken out of the first location, before hearing about its new location.

In Study 1 (N=24), children always heard the new information in an outer room in the absence of any visual information. In Study 2 (N=23), children heard the new information in view of the possible hiding places. Children searched correctly more often than chance in both conditions (Binomial tests:  $p_s < .001$ ). There were no significant differences between verbal and visual conditions in Study 1 or 2. Thus, facilitating the removal of irrelevant information leads to successful updating in 23-month-olds. Children also performed better when they heard the new information in view of the possible hiding locations than in their absence.

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**PC-020**

**Preschoolers Enforce Novel Prosocial - But Not Selfish - Sharing Norms**

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Human cooperation and group living depends on individuals who share some common norms and values (Schmidt & Tomasello, 2012). Whereas some research has found that preschoolers tend to be rather selfish when it comes to sharing resources (Smith et al., 2013), other research shows that even very young children can act prosocially (Kuhlmeier et al., 2014; Warneken & Tomasello, 2006). Young children also understand and care about moral norms, enforce them, and negatively evaluate selfish behavior and unfairness (Cooley & Killen, 2015). Thus it is not known whether children understand agreed-upon selfish versus prosocial sharing norms as binding. We used a group dictator game in a norm creation paradigm (Schmidt et al., 2016) to investigate whether 5-year-old children understand selfish versus prosocial sharing decisions as generalizable and binding.

Children (N=24) and two puppets (proposer, target) agreed upon either a prosocial norm (each group member shares with a child from another kindergarten) or a selfish norm (no sharing). To test whether children understood the suggested norm as binding, we confronted them with a target puppet either following or violating the suggestion in the test phase. We measured children's spontaneous protest against the target puppet deviating in a selfish vs. prosocial way. Preliminary results (n=19) suggest that preschoolers understand prosocial, but not selfish, agreements as binding (McNemar's-test,  $p=.008$ ). These results indicate that novel norms gain their normative force not only from agreement or expectations of conformity, but also from considerations of the content (i.e., being prosocial vs. selfish) of the proposed norm.

**PC-021**

**Sharing within children’s relationships**

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Children’s friendships and sibling relationships form important developmental contexts. On the issue of moral development, sharing as a positive duty becomes important from the beginning in both relationships (cf. Youniss 1984, Dunn 1995). Depending on the particular relationship and its quality, I suppose that children feel obligated to moral norms. To investigate how children in the 5 to 6 age group (n = 83) decide and reason about their siblings versus their friends on the issue of sharing, they had to decide hypothetically to whom to give a sweet. 41% of the children decided to give the sweet to their sibling, 37% decided to give it to their friend, overall 22% found it hard to decide. Their justifications revealed that the children referred to the context of the relationship in about 80%. Categories such as sanctions, norms or reciprocal distribution weren’t striking. Second, the children were put in the role as recipient. Their friend hypothetically decided to share the sweet with his sibling instead of the child as well as their sibling decided to give the sweet to his friend. What stood out in both cases was that the children again referred to the context of the relationships. They tried to balance the mismatch and could understand if their friend gave the sweet to his sibling. Altogether, the children’s justifications suggest that as soon as the decision takes place in the context of the relationship, their knowledge about the duty fades from the spotlight and is conquered by the context.

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**PC-022**

**16-month-old infants reward fair individuals but do not punish unfair individuals**

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Infants’ proclivity to reward and punish has been examined in response to helpful and harmful behavior (Hamlin et al., 2011), however it is unclear whether such interventions are applied toward fair and unfair individuals.

Sixteen-month-old infants were taught to reward and punish using a touchscreen: touching one side of the screen caused a hand to appear and deliver a cookie to a novel actor at the center of the screen, whereas touching the other side of the screen caused a hand to appear and take a cookie away from the actor. Infants then saw third-party resource distribution clips in which one actor distributed resources fairly and another actor distributed resources unfairly. During six alternating 10-second test trials the fair or unfair individual appeared at the center of the screen while infants’ touches on the screen sides were recorded.

Participants ( $n = 30$ ) touched the reward side significantly more than the punishment side when the fair distributor was presented on screen ( $t(29) = 2.25, p = .032$ ), yet touched both screen sides equally when presented with the unfair distributor ( $t(29) = .24, p = .82$ ). Furthermore, examining infants' first touches on each trial type revealed significantly more first touches on the reward compared to the punishment side on fair trials ( $t(29) = 3.46, p = .002$ ), but no difference in their first touches on unfair trials ( $t(29) = .27, p = .79$ ).

Our findings reveal that infants actively reward fair individuals, but do not punish unfair individuals.

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**PC-023**

**Quantifying with mental files: some developmental data**

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Francois Recenati's theory of mental files is properly formulated to handle mental state attribution to others, and it has recently been put to use in studies of mentalization development. An outstanding issue within this framework is how to accommodate quantificational statements using mental files. We designed two tasks that require the combination of mentalization and number concepts to address this issue. In the False belief with counting (FBC) task subjects ( $n=97$ ) saw an assistant put a certain number of balls in a box, then leave, followed by another assistant who dropped one more ball in the box. On return of the first assistant who either peeked or did not peek in the box Ss were asked how many balls she thought there were in the box. In the Decentration plus number (DN) task subjects saw a given number of toy mushrooms on a table, and a Papa Smurf character on the opposite side of the table who was only able to see a subset of the mushrooms. We asked subjects how many mushrooms Papa Smurf saw. 8-9-year-old subjects who passed the standard false belief test and the Give-a-number task had considerable difficulty with the FBC task (47% passed) whereas they found the DN task easier (79% passed). This indicates that combining concepts from different knowledge domains is difficult. For a more detailed explanation we suggest that in certain circumstances children (and adults) can open set files, that is, files that refer to sets of objects, and can indicate their numerosity.

**PC-024**

**The role of cognitive control development in Tourette syndrome**

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Tourette syndrome (TS) is a childhood-onset neurodevelopmental disorder characterized by motor and vocal tics. In most cases, tics decline or disappear by late teenage years, however it is not clear whether this spontaneous recovery is related to cognitive development. While some studies showed no executive functions (EF) differences between TS to typically developing subjects (TD), others found EF impairments in TS patients. However, recent studies reported increased executive functioning in a group of young TS patients. These findings led to the speculation that enhanced EF might serve as a compensation mechanism. The current study aims to explore possible EF differences between young TS patients and TD children, and to follow EF development in the TS group in order to explore its possible links with tics reduction. The EF profile of 32 young patients diagnosed with TS was compared to 32 TD children using a battery of specific EF tasks including cognitive control, task switching, planning and working memory. Other cognitive skills were compared as well. Results showed a specific EF impairment in the TS- boys group, as measured by the ability to accurately shift between mental sets. Follow up examinations of the TS group employing same tests revealed significant correlations between accurate shifting improvements to TS symptoms reduction. These findings suggest that TS patients show specific EF impairments in childhood. Moreover, the development of the EF system observed in young TS patients may have a role in the symptoms reduction observed later in life.

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**PC-025**

**The Costs and benefits of self-righteousness: A developmental investigation**

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Moral condemnation is ubiquitous in human societies and appears early in development. Infants dislike hinderers (Hamlin, Wynn, & Bloom, 2007) and preschoolers frequently tattle on others (den Bak & Ross, 1996,1998). Although the existence of moral condemnation is clear, it is unclear why it is so common. We hypothesize that moral condemnation serves as a signal that one is a moral person who disapproves of the condemned action and is unlikely to commit the act. If moral condemnation is a signal, however, then signal honesty requires there be a cost to such condemnation. We further hypothesize that although condemnation may protect one from others' accusations, if one

condemns hypocritically and is caught committing a condemned action, one may be judged more harshly than someone who never condemned that action. We found support for these hypotheses and explored the development of these inferences in children. Children (n=121, age 4- to 11-years-old) were presented with a vignette about two classmates, one with a history of condemning stealing and one without. They were asked about each child's likelihood of stealing and which child should be punished more after both were subsequently caught stealing. By age 7, but not younger, children thought that someone who condemns stealing is less likely to steal than a non-condemner, but thought these same condemners should receive more punishment when caught stealing. These results provide evidence for sophisticated inferences about the emerging understanding of a system of costs and benefits to condemnation and moral hypocrisy.

**PC-027**

**The interplay of word and category knowledge in early childhood**

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Word and category knowledge seem to share a reciprocal relationship during early development (Gopnik & Meltzoff, 1987) with word knowledge reshaping category knowledge (Westermann & Mareschal, 2012), and with category knowledge directly influencing word learning (Borovsky & Elman, 2006). In the current study, we examined children's semantic connections within broad and narrow categories, their word learning abilities, and the direct connection of these two areas.

In an intermodal priming study, we investigated whether 2- and 3-year-olds (N=35 and N=37) would show a target preference in broad conceptual categories (fruit) rather than narrow categories (musical instruments) in primed (strawberry – banana) and neutral (guitar – banana) conditions. In a second word learning study, children were introduced to novel word-object pairings in broad or narrow categories, and later tested on their target recognition. Additionally, we administered an adapted version of the German CDI as an indicator of children's individual category densities.

Preliminary analyses indicate that both age groups showed priming effects in broad categories in contrast to unprimed conditions (p=.002). However, only 3-year-olds demonstrated word learning in narrow categories (p=.043), which was negatively correlated with the observed priming effects (r=-.409, p=.022). These results suggest that toddlers implicitly differentiate between dense and sparse categories with dense categories having stronger links between concepts, and acquire novel concepts more readily in sparse categories. This reflects a direct connection between conceptual structure and word learning, even on the level of underlying cognitive processes, and further reveals how categorisation and word learning develop in concert.

**PC-029**

**The evolutionary origin of the consonant bias in word processing**

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Once a lexicon is established, adults and infants tend to rely more on consonants than on vowels to recognize lexical items, in what is known as the consonant bias (e.g. Nespor et al., 2003; Nazzi et al. 2016). One hypothesis is that this asymmetry derives from general perceptual biases, based on the physical characteristics of consonants and vowels (Lameira et al., 2013). Indeed consonants are shorter, more discrete and typically more variable than vowels, which are usually longer, louder and continuous.

This study investigates the consonant bias in a non-human animal (i.e. rats). If consonants are better targets for identifying and memorizing individual items like words even in absence of linguistic representations, than rats should exhibit a consonant bias.

Thirty-two rats learned to discriminate between different sets of disyllabic words (e.g. papá, mano, calle, vida). Rats were then tested on two different versions of these words: consonant mispronunciations (e.g. dada, pano, malle, kida) vs. vowel mispronunciations (pepé, meno, celle, veda).

Results show that rats responded more to consonant mispronunciation (mc=38.6) than to vowel mispronunciations of the words (mv=33.8) [  $F(1,31)=11.2$ ;  $p=.002$ ], suggesting that the vowel mispronunciations had more impact on their recognition of a word-form than consonant mispronunciations.

Animals and infants before 5 months of age (Bouchon et al., 2014) use the most salient category of speech sounds (vowels) to encode word-forms. The present results also suggest that the human specific predisposition for language is necessary for consonants to become better targets when recognizing words.

**PC-030**

**Causal learning in children**

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Human adults have two routes to learning new things: they can associate two arbitrary events (i.e. sirens and emergencies) or they can find a causal explanation (i.e. splashes caused by falling objects). The previous research examining young children’s development of causal learning suggests that children are like “scientists” from the beginning; they observe regularities in the environment, they interpret evidence and make interventions to test their predictions (Gopnik & Wellman, 2012). However, it has also been demonstrated



that the use of causal language in these paradigms might be scaffolding young children's abilities (Bonawitz et al., 2010). The current study examines the development of causal learning in children with a design that does not depend on linguistic explanation. Three to six year old children (N= 128) are presented with an event in which a reward is dropped into a forked tube into one of the two cups. Children must learn to use an auditory cue to locate the reward. In the causal condition, the cue follows the dropping event, making it plausible that the sound is caused by the reward falling into the cups; and in the arbitrary condition, the cue precedes the dropping event, making the relation arbitrary. It is hypothesized that children will perform better in the causal than in the arbitrary condition if they can reason about the causal structure. The findings will be discussed in light of two developmental accounts that explain how children learn about causality in the world (Gopnik et al., 2001; Karmiloff-Smith, 1992).

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**PC-031**

**Children's Representations of Mental States as a Function of Group Membership**

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When people are perceived in terms of group membership, individual differences tend to be overlooked. A problematic instance of category-based perception is the out-group homogeneity effect: Whereas in-group members are readily thought of as individuals, out-group members are rather seen as homogeneous, mutually interchangeable exemplars of their group (see Boldry et al., 2007). So far, little is known about the developmental origins of this bias. In an ongoing study, we investigate children's theory of mind reasoning as a function of group membership: are children less likely to ascribe diverging mental states to out-group as compared to in-group members?

3- to 4-year-old and 6- to 7-year-old children are being tested (n = 40 envisaged; n = 21 tested so far). On a touchscreen device 12 vignettes about pairs of either in- or out-group members are presented (between-subjects design; group membership minimally induced by German or Turkish prenames). In each trial the mental states (here: believes or desires) of the two protagonists differ as for the location of an object. After a distraction task, participants are asked to remember the locations. The distance between both locations serves as a measure for the ascribed heterogeneity of mental states. This newly developed paradigm is based on a continuous false belief task by Sommerville et al. (2013).

Preliminary data cannot support our hypothesis. However, the negative results of a manipulation check (in the out-group condition none of the children recognized a Turkish nationality) suggest a stronger marking of protagonist's group membership being necessary.

**PC-032**

**Reciprocity after giving and taking revisited**

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When preschoolers are given resources and are told to freely share them with another child, they often act selfishly. This tendency is stronger among younger children (cf. Ibbotson, 2014). Recent research focused on reciprocal behavior, showing that even three-year-olds are more generous if someone gave to them first (e.g., House et al., 2013). In a study by Vogelsang and Tomasello (2016), children either experienced distributions by a puppet as giving (i.e., the puppet shared candy given to her with the child) or as taking (i.e., the child was given candy and the puppet took some) and were asked to reciprocate, that is, to take from the taker and give to the giver. One might expect children to be more reluctant to take, but the results showed the opposite effect: In the taking condition, where taking was legitimized by the experimenter, children obtained more candy than in the giving condition. However, children might have acted more selfishly in the taking condition because of the instruction and not only because of their prior experience. Therefore, a new study combines the method of Vogelsang and Tomasello (2016) with a more indirect forced choice paradigm (e.g., Fehr, Bernhard, & Rockenbach, 2008). Four- to five-year-olds first experience a puppet taking candy from or giving candy to them, and subsequently choose between different allocations of candy for themselves and the puppet. Children in the giving condition should still make more prosocial choices than those in the taking condition. Preliminary results confirm this hypothesis.

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**PC-033**

**Do young children test counter-intuitive claims?**

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We presented children between 3- and 6-years (N=64) from Minsk, Belarus with five different-sized Russian dolls for visual inspection and asked them which one was the heaviest. All children stated that the biggest doll was the heaviest. We then provided half of the children with counter-intuitive testimony, telling them that the smallest doll was the heaviest and that the biggest was the lightest, a claim that was false. The other half of the children received testimony that confirmed their intuitions (i.e., that biggest=heaviest). When subsequently questioned, the majority of children who received counterintuitive testimony endorsed the claim that smallest=heaviest. Next, all children were given an opportunity to seek empirical evidence by picking up the dolls when the experimenter left the room. Children's final

judgements about the weight of the dolls following the experimenter's return were related to their exploration of the dolls. Children in the counterintuitive testimony condition who engaged in more extensive exploration of the dolls were significantly more likely to revert to their initial intuition that biggest=heaviest. Nonetheless, a considerable proportion of children did not seek additional evidence and continued to endorse the counter-intuitive testimony they received. Thus, for some children counter-intuitive testimony may set in motion a process of inquiry that culminates in children's longer-term acceptance or rejection of what they were told based on the evidence they collect. An important goal for future research is to explore why children differ in their propensity to test a counter-intuitive claim when given the opportunity to do so.

**PC-034**

**Bridging small and large numerosities: the case of newborn infants**

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Infants possess two systems to represent numerical information: a system for small, precise, numerosities (1-3) and an approximate system for large numerosities (4 and more). The format of the representations outputted by these systems are fundamentally different, and indeed infants often fail to compare numerosities across the small and large ranges. For example, in habituation tasks 6-month-olds can discriminate large numerosities when they are separated by a 2:1 ratio (4vs8, 8vs16, 16vs32), however they fail to compare a small vs. a large numerosity in the same conditions (2vs4).

In our previous work, we observed a similar discontinuity between small and large ranges at birth. When presented with stimuli in the auditory (sequence of tones) and visual (array of shapes) modalities, newborns (0-4 days) detected matching vs. non-matching numerosities separated by a 3:1 ratio (3vs9, 4vs12, 6vs18), but failed to discriminate between a small vs. a large numerosity with the same 3:1 ratio (2vs.6).

Yet, for older infants, representations of small and large numerosities are not fully incommensurate: 7-month-olds can succeed at comparing small vs. large numerosities in certain circumstances, for example when the ratio between the small and large numerosities is increased (2vs8, a 4:1 ratio). Here we found the same pattern in newborns: when tested with a sufficiently large ratio (6:1 rather than 3:1), newborn infants successfully matched numerosities 2vs12 in our audio-visual paradigm. Thus, just like older infants, newborns are able to represent large and small numerosities in a shared format, albeit with decreased precision.

**PC-035**

**Children’s readiness to learn socially-relevant information from the demonstrators sharing the same language with them:**

**An over-imitation study**

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We argue that over-imitation is a byproduct of children’s readiness to learn socially relevant information from reliable epistemic sources. To test this we employed an over-imitation paradigm by Hoehl et al. (2014).

In Experiment 1, participants were 32 4-year-olds. They first saw an agent who ostensibly demonstrated how to retrieve a sticker from a novel puzzle-box inefficiently. Subsequently, a second demonstrator came in and retrieved a sticker from the same puzzle box efficiently. Participants had two imitation-phases after each demonstration. For half of the participants the first demonstrator was an agent speaking their own language and the second demonstrator was a foreign-language speaker, and vice-versa for the other half. We found a statistically significant interaction between the imitation-phase and experimental condition,  $F(1, 30) = 8.9, p = .006, \eta^2 = .22$ . Upon, later seeing the efficient demonstration participants reduced their rate of over-imitation only if this second demonstrator spoke their native language. In Experiment 2, 4-year-olds ( $N = 16$ ) first saw a foreign-language speaker ostensibly demonstrating how to receive a sticker efficiently, followed by their own language speaker demonstrating how to receive a sticker inefficiently. Despite viewing the efficient demonstration modeled by a foreigner first 4-year-old children still faithfully copied subsequent inefficient demonstration performed by their own-group member,  $F(1, 15) = 16.56, p < .001, \eta^2 = .52$ .

Data-collection with 5-year-olds is still ongoing. However, for now, these results are consistent with the notion that over-imitation could be a phenomenon reflecting readiness to treat communicative actions as demonstrations of socially relevant knowledge.

**PC-036**

**“I’m not touching you”: Children privilege the “Spirit of the Law” over “Letter of the Law”**

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Developmental psychology has a long-standing commitment to studying children’s moral judgments and early reasoning about rules (for a review, see Turiel,1998). However, this previous research has failed to address a critical issue that is involved in making moral

judgments about people—understanding the intent behind an existing rule (“Spirit of the law”). Here, we investigate the developmental roots of this capacity by examining when and how children begin to distinguish between the letter and spirit of the law. Participants ages 4-10 (Study 1: N=108, Mage= 7.05; Study 2: N= 75, Mage=7.05; Study 3: N=65, Mage= 7.19)) were asked to evaluate a rule-breaker who either 1) violated the “Sprit of a law”, or 2) only the “Letter of the law”. In three studies using different vignettes and rules, we find that, by age 4, children appear to understand the importance of the intent behind rules: While children recognized the rule had technically been broken in both cases, they were much more likely to punish and negatively evaluate someone for violating the “Spirit of the law” as compared merely violating the “Letter of the law”. This finding was replicated across three studies, controlling for the outcome of the rule violation and introducing two different types of rule-breaking vignettes. We discuss how these studies provide insight into children’s early notions about moral norms.

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**PC-037**

**Body image in individuals with autism spectrum disorder**

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Autism spectrum disorder (ASD) is a neurodevelopmental disorder. While many studies have revealed that individuals with ASD have difficulties with interpersonal skills, such as communicative skills, little attention has been paid to intrapersonal skills. Recently, autobiographical accounts by individuals with ASD show atypical intrapersonal skills. However, few studies have examined the atypicalities of intrapersonal skills in other individuals with ASD. We explored self-body awareness (body image), one of the intrapersonal skills, in individuals with ASD and typically developing individuals by asking them own body size estimation. In Experiment 1, participants were asked to match apertures of two partitions to their shoulder width. In Experiment 2, participants were asked to draw their shoulder width vertically on a whiteboard. Both in Experiment 1 and 2, typically developing individuals estimated their shoulder width more accurately than individuals with ASD. However, individuals with ASD overestimated their shoulder width in Experiment 1 and underestimated it in Experiment 2. This study suggests that individuals with ASD have an unclear body image. We discuss the underlying factors explaining the inaccuracy in body size estimation.

**PC-038**

**Count Noun Labels Facilitate Relational Thinking about Same and Different Kinds**

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Psychologists have proposed that abstract, relational concepts like ‘same’ and ‘different’ may differentiate human and animal minds (Penn et al., 2008). Indeed, non-human animals without symbolic training and children under five generally fail at relational match-to-sample, or rMTS (Premack, 1983; Thompson & Oden, 2000; Hochmann et al., under review). Hoyos and colleagues (2016) show that children also fail rMTS if they first complete a task labeling objects using count nouns (i.e. “That’s a ball!), suggesting that noun learning encourages individual focus and hinders relational thinking in preschoolers. However, a count noun label not only demarcates a single object, but also specifies a potentially infinite group of individuals belonging to the same kind (Xu, 2007). In three studies, we test the hypothesis that count nouns might facilitate rather than hamper rMTS performance if this aspect of noun meaning, namely same or different kind membership, is emphasized. Study 1 shows that 4-year-olds succeed at rMTS with known kinds when given training with count noun labels (i.e. “This is a lion and this is a lion!”). In contrast, Study 2 shows that 4-year-olds fail without labels. Using rMTS with novel kinds, Study 3 shows that 5-year-olds succeed with novel nouns (i.e. “This one is a dax and this one is a dax!”) but not adjectives (i.e. “This is a daxy one and this is a daxy one!”), ruling out the possibility that verbal repetition facilitates rMTS success. Thus, our results demonstrate that noun learning alone cannot account for preschoolers’ failures at relational thinking.

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**PC-039**

**Improving mathematical abilities with digit quantity relation training in 7-8 year old children**

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Research suggests that training the approximate number system could improve children's mathematical skills. This training aims at enhancing the ability to distinguish quantities, such as sets of dots, not directly related to digits, properties of numbers, or the syntax of the numerical system. Here we explore a kind of numeric training focused on improving the understanding how digits refer to specific quantities.

The motivation for this procedure is based on the observation that the relationship

between digits and quantities in mathematics is similar to the relations between words and objects in natural language. Both need to be learned and understood to develop proficiency in their respective domains.

Building on our previous results, we directly compared the effectiveness of training approximate number comparison to that of training the digit-quantity relation. Seven-to-8 year olds were assigned to one of the two training regimes for three weeks (n=46 and 45, respectively). We examined how children's skills in applying algorithms such as addition and subtraction changed as a function of training. Overall, training the digit-quantity relation improved arithmetical abilities more than training approximate number comparison. We speculate that training the digit-quantity relation improves the understanding of basic mathematical language, giving children a firmer grasp on what digits represent. Our results suggest that, over and above the potential advantages offered by approximate number training, directly improving a crucial aspect of mathematical language has an further effect, offering the possibility to develop novel strategies to improve children's early mathematical performance.

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**PC-041**

**Is the principle of rationality in infancy used to predict social affiliations?**

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Based on the principle of rationality, pre-verbal infants expect individuals to act using the most efficient way to achieve their goals (Gergely et al. 2002; Skerry et al. 2013).

All the studies that addressed this principle used non-social contexts. However, people's actions usually take place in a social environment, where their behaviours influence the way other individuals interact with them (Singer et al. 2006).

Taking into account that infants are sensitive to the link between people's behaviours and social affiliations (Lieberman et al. 2014; Powell & Spelke, 2013), here we address whether the rationality of others' behaviours is used to generate expectations about third party affiliations.

By using an eye-tracker we record 15 old-months infants' eye gaze behaviour while watching short animations, where an agent observes two other agents jumping a constraint to get a reward. At some point, the constraint is removed and one agent adapts his trajectory to a shorter one to get the reward (rational agent), while the other agent keep doing his old long-path trajectory (irrational agent). Finally, both agents go to call the observer simultaneously and he has to choose to affiliate with the rational agent (congruent affiliation) or with the irrational one (incongruent affiliation).

Data collection is still under way. Preliminary data point in the direction of infants being surprised when seeing the incongruent affiliation as compared to the congruent one.

**PC-042**

**The Role of Pragmatic Factors in Children’s True Belief Competence**

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One of the recent puzzles in Theory of Mind (ToM) research is the U-curved development of true belief (TB) ascription competence in 4- to 6-year old children: Surprisingly, children start to fail in TB tasks as soon as they master false belief (FB) tasks. It is currently unclear whether this failure of older children in TB tasks reflects lack of conceptual competence or simple performance limitations. One potential limiting performance factor is task pragmatics:

The most obvious pragmatic peculiarity of TB tasks is that, in contrast to FB tasks, the test question is trivial (i.e. one asks about the belief of the protagonist that accords (a) both with the reality and (b) the child’s own belief). We tested this in Study 1 (N=101) by modifying the procedure in a way that makes the TB of an agent more relevant and thus the test questions less trivial. Results showed that the U-curved pattern disappears and children from age 4 perform at constant high levels on TB and FB tasks.

A more specific pragmatic performance factor may be that children assume that they are asked non-trivial question especially when the subject-matter is the belief of another agent. We tested this account in Study 2 (N= 31) by contrasting FB and TB tasks with false and true photo tasks, showing that the U-curved development is limited to belief ascription.

Taken together these findings speak in favor of a performance based explanation of the classic U-curved TB pattern.

**PC-043**

**Language Training induced Changes in Cortical Thickness of the Developing Brain**

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The developing brain is subject to a myriad of maturational changes. In early childhood the brain volume increases as cortical surface area (SA) expands and cortical thickness (CT) decreases. At the same time language acquisition progresses quickly as children perceive, process, and produce language. We were interested in whether the language learning process and brain development could be assisted by intervention. Therefore we examined if children could be trained in specific language features and how the resulting changes in behavior would be reflected in the brain, specifically in CT and SA. We conducted a 3-week training study with four year old children and collected MRI data pre and post intervention. Participants were split into three groups: semantic training (SEM), syntax training, or



control (CON). The SEM group underwent a lexical training of 60 pseudo animals and their corresponding labels. Here we report results from SEM and CON. We hypothesized an increase in CT in language related regions of the brain, i. e. inferior frontal, temporal, and inferior parietal regions for participants who underwent language training and a decrease for those who did not. In an ROI analysis of CT we found a significant difference in changes from pre to post intervention in left pars triangularis (BA45) when comparing SEM and CON, where CON shows a decrease in CT and SEM shows no difference. We interpret this group difference as semantic training counteracting the developmental change in the control group and that the language network is susceptible to training induced changes.

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**PC-044**

**How imitation develops - changes in children's social learning throughout childhood**

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Children are capable of both selective and faithful imitation throughout childhood. We argue that children’s social learning goes through several developmental stages, at which children have different ‘default stances’ as to copy precisely or selectively. We present results from two studies that investigate how children imitate two models who demonstrate—in each other’s absence—different ways of achieving the same novel goal. In Study 1 we present results from a cross-sectional study of children aged 2 to 12 years, finding evidence of developmental changes in their imitation of successive models at around 3 years and at around 6 years. Children below 3 tend to reproduce only the first solution that they observe, whereas children over 6 begin to copy the two models more faithfully, thus flexibly switching between two ways of achieving a goal – this flexibility increased substantially and continually until 12 years. In Study 2 we investigate the effect of the identity of the models on imitation fidelity in pre-schoolers: we replicate the previous age effect of younger children keeping with the first solution, but find that when the second model is an adult rather than a puppet, older children are more likely to copy the adult. We conclude that there are changes in the way children perceive social learning situations, and in particular that the tendency to faithfully copy one’s counterpart is an indication of more flexibility in imitation.

**PC-045**

**The emergence of the consonant bias in Spanish learners in their first year of life**

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Consonants carry more lexical information than vowels and adults universally rely more on consonants in lexical tasks (Nespor et al., 2003). French learners switch from to a consonant bias between 5 months (Bouchon et al., 2014) and 8 months (Nishibayashi & Nazzi, 2016), Italian learners, between 6 and 12 months (Hochmann et al., 2011), while English learners rely equally on consonants and vowels until 30 months (Nazzi et al., 2009).

This study investigates for the first time the consonant bias in infants learning Spanish, a language with a limited vowel inventory, therefore hypothetically more lexically informative consonants. A gaze contingent preferential looking task tested the impact of consonants vs. vowels mispronunciations on word recognition at 5, 8 and 12 months.

The control experiment confirmed the familiarity of the 18 frequent Spanish words (mamá, niño...). In the test experiment infants prefer consonant mispronunciations of familiar words (nana, biño...) at 5 and 8 months, while 12 month-olds prefer the vowel mispronunciations (meme, neño...), yielding a marginal interaction with age [ $F(2,38) = 2.8, p = .08$ ]. This suggests a later switch to a consonant bias in Spanish later than in French, perhaps due to the difference in C/V ratios in their input.

Results on 55% of our final sample (for each age and experiment, 20 participants will be tested) will bring new insights on the cross-linguistic factors determining of the age of emergence of the consonant bias.

**PA-032**

**Children’s understanding of the art of manga drawing**

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Japanese “manga” (comics) have been gaining popularity worldwide. To understand stories from picture frame sequences, readers must share a knowledge of the implicit rules that govern manga’s unique drawing style, which could be considered analogous to camera work when shooting a film. To investigate children’s understanding of the expressive rules of manga, we presented two manga stories to 6- and 7-year-old children (N=26). Each story consisted of a series of 5 pictures showing two boys. One of these series was as follows: (1) two boys meet on a street, (2) they greet each other, (3) a close-up of a surprised face,

(4) a close-up of a red shoe on a right foot and a black shoe on a left foot, (5) a back view of a boy pointing at the mismatch. Children were asked to identify the boy wearing the mismatched shoes. A close-up face in manga often indicates that the next frame shows what that face is looking at. Thus, the subjects who understood this rule considered that the boy wearing the mismatched shoes in the fourth and fifth pictures was not the boy in the third picture. As a result, most of the participants (62.5% of the 6-year-olds and 71.4% of the 7-year-olds) correctly understood the rule. Age, TV viewing time, book reading time and vocabulary score (PVT-R) did not correlate with the performance. The findings will be discussed in relation to the development of perspective taking and also with additional experiments regarding theory of mind.



PRE-CONFERENCE  
SESSION

# Eye tracking in developmental studies

## Tobii Pro eye tracking workshops

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Eye tracking plays an important role in gathering data about how infants and children interact with the people and the world around them. Successful studies require attention and care to obtain reliable data and properly process and analyze.

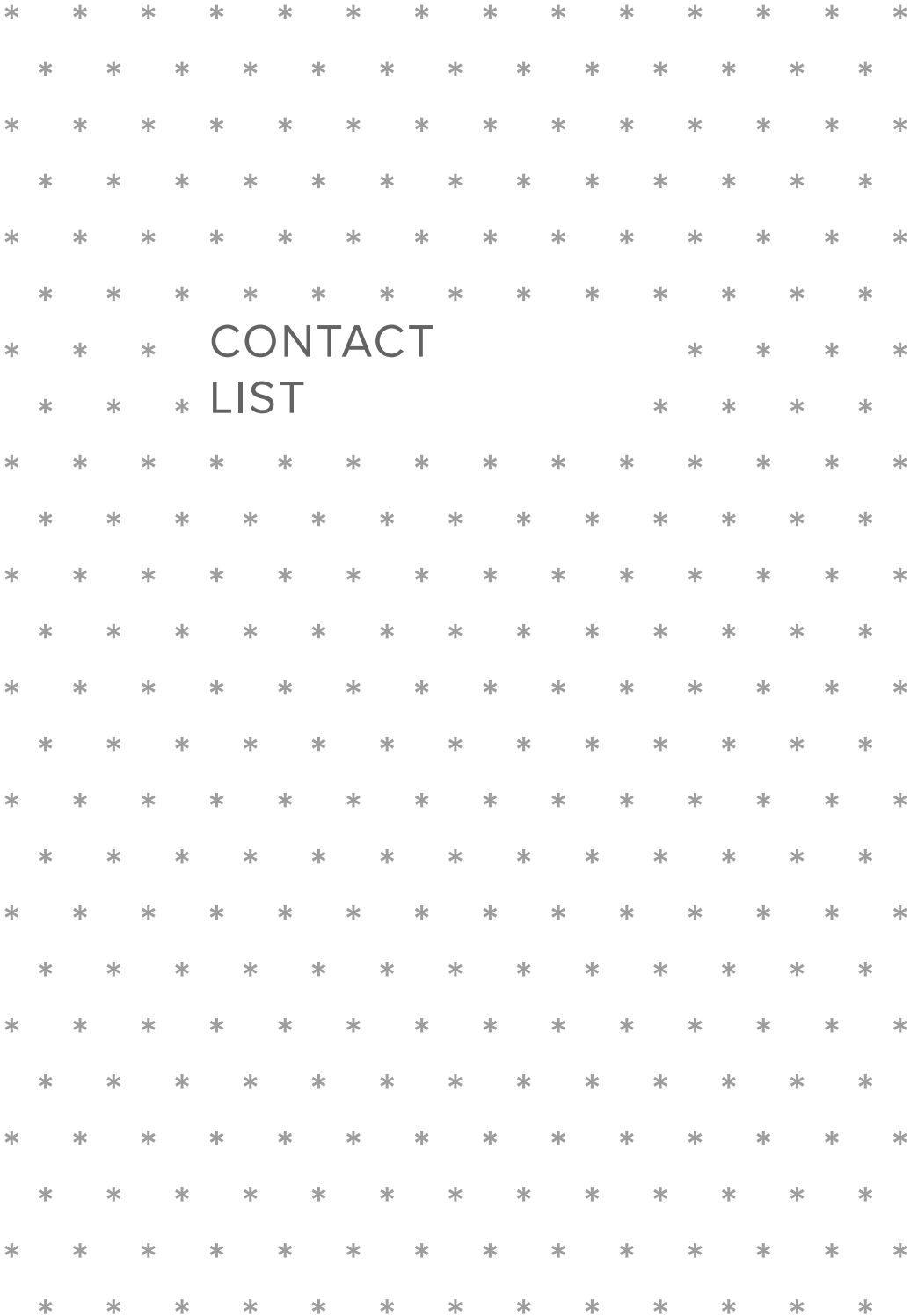
We offer two workshops where we will discuss common paradigms and best practices for high quality studies. Each workshop will allow for 20 people to attend, to ensure hands-on time for all attendees. The workshops are aimed mainly at beginner to intermediate levels, but more advanced users are very welcome as well.

**We will present**

- common paradigms used in infant research
- best practices when working with infants and young children
- best practices for high quality data and validation
- possible experimental design issues

Participants will have the chance to try out Tobii Pro's remote and wearable eye trackers and the different eye tracking software.

About Tobii Pro: Tobii Pro eye trackers are known for their exceptional tolerance of substantial, dynamic head movement which allows for minimal restrictions on the subjects' natural actions. This makes them ideal for infant and child studies, as well as atypical populations.



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RESTAURANTS  
& MAPS

**A, Conference venue****- Radisson Blu Béke Hotel**

1067 Budapest, Teréz körút 43.

**B, Gala dinner venue****- Danubius Hotel Gellert Budapest**

1111 Budapest, Szent Gellért tér 1.

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**1. Arriba Taqueria**

1067, Teréz körút 25.

[www.arriba.hu](http://www.arriba.hu)

*Mexican*

**2. Barokko Club & Lounge**

1065. Liszt Ferenc tér 5.

[www.barokko.hu](http://www.barokko.hu)

**3. Braseiro Restaurant**

1061 Teréz Krt. 23.

*Brazilian*

**4. Broadway Garden Restaurant and Coffee**

1066 Ó utca 43-49.

**5. Buena Vista**

Liszt Ferenc tér 4-5.

[www.buena-vista.hu](http://www.buena-vista.hu)

**6. Cactus Juice Pub & Restaurant**

1061 Jókai tér 5.

[www.cactusjuice.hu](http://www.cactusjuice.hu)

**7. Csirke-fogó**

1065 Bajcsy Zsilinszky u. 7.

[www.csirkefogo.hu](http://www.csirkefogo.hu)

*Fast food*

**8. Dimitrisz Restaurant**

1067 Eötvös utca 25/a

[www.dimitriszpub.hu](http://www.dimitriszpub.hu)

*Fast food*

**9. Westend underground food corner**

**(Don Pepe pizzeria, Istanbul turkish restaurant,**

**Thai restaurant, Chinese restaurant, Nordsee,**

**Mediterranean Grill restaurant)**

West End Shopping Center

<http://www.westend.hu/hu>

*Fast food*

**10. Grappa Restaurant**

1067 Teréz Krt. 25.

**11. Hang Zhou Kínai Chinese Restaurant**

1065 Podmaniczky u. 1-3.

*Chinese*

**12. Horvát Restaurant**

1065 Nagymező u. 49.

*Hungarian*

**13. Indigo Restaurant**

1066 Jókai u. 13.

[www.indigo-restaurant.hu](http://www.indigo-restaurant.hu)

*Indian*

**14. Istanbul Turkish Restaurant**

1067 Teréz Krt. 23.

[www.istanbuletterem.hu](http://www.istanbuletterem.hu)

*Turkish*

**15. Napos Oldal**

1066 Jókai u. 7.

[www.naposoldal.com/en/restaurant](http://www.naposoldal.com/en/restaurant)

*Vegan/Vegetarian*

**16. Parazs Presszo**

1066 Jokai u. 8.

[www.parazspresszo.com/node/119](http://www.parazspresszo.com/node/119)*Thai***17. Café Bouchon**

1066 Zichy Jenő u. 33.

[www.cafebouchon.hu](http://www.cafebouchon.hu)*Hungarian***18. Funky Pho**

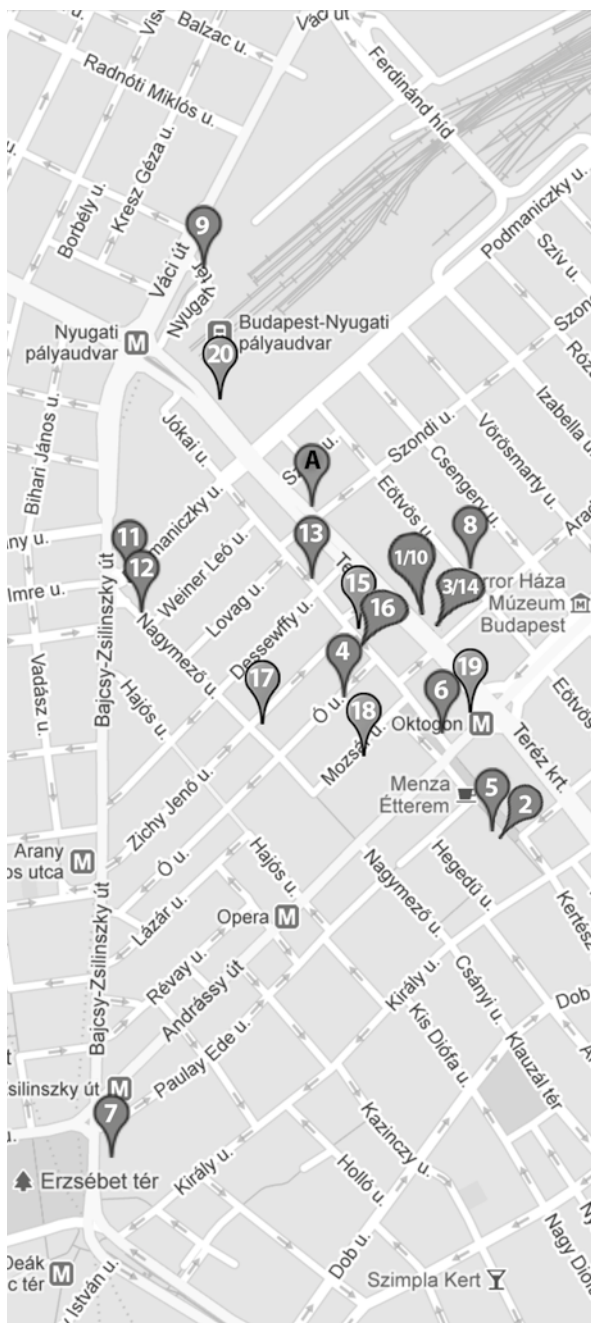
1066 Mozsár u. 7.

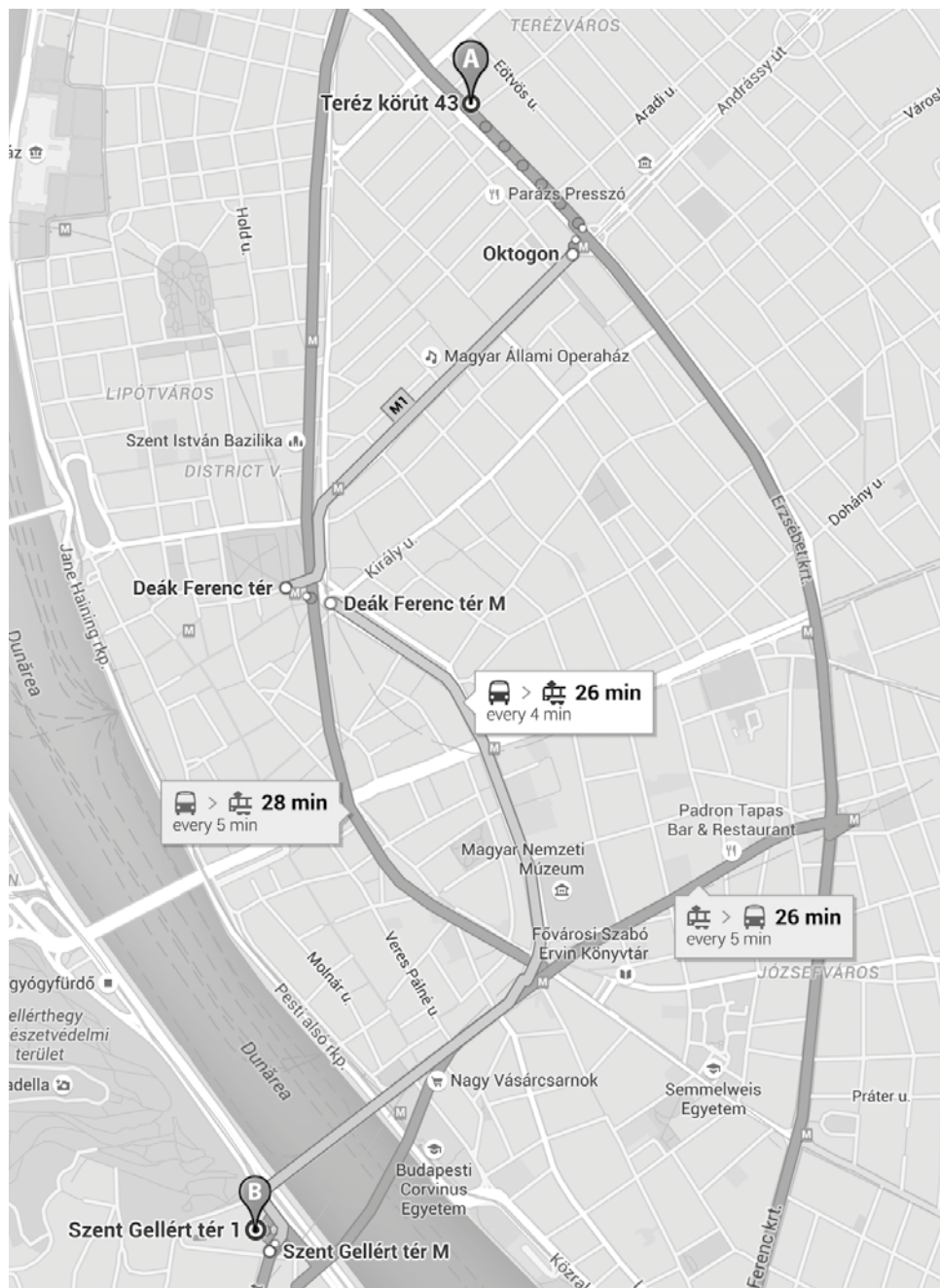
[www.funkypho.hu](http://www.funkypho.hu)*Vietnamese***19. Bellozzo**

1066 Oktogon tér 1.

[www.bellozzo.hu](http://www.bellozzo.hu)*Italian***20. Nu Bor es Bisztronomia**

1062 Tereztér, 55.

[www.bisztronomia.hu](http://www.bisztronomia.hu)*Hungarian*



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