



BCCCD 2016

BCCCD 2016

Budapest CEU Conference on Cognitive Development
Program and Abstracts



BCCCD 2016

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ORGANIZED BY

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The conference is organized by the Cognitive Development Center
at CEU Cognitive Science Department

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SCHEDULE

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.....
January 6, Wednesday

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

.....
January 7, Thursday

BCCCD16 PRE-CONFERENCE SESSIONS

08:00 - 19:00 **REGISTRATION**

08:45 - 10:00 **TOBII PRESENTATION**

Eye tracking data quality, validation, and fixation classification

10:00 - 10:20 **COFFEE BREAK**

10:20 - 12:00 **TOBII WORKSHOP**

10:20 - 12:00 **LUNCH**

BUDAPEST CEU CONFERENCE ON COGNITIVE DEVELOPMENT 2016

13:00 - 13:15 **BCCCD16 WELCOME**

13:15 - 15:15 **REGULAR SYMPOSIUM 1**

Development and evolution of memory and planning

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

17:15 - 18:45 **PAPER SESSION 1** Reasoning

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

A bird's eye view of human cognition
 Nathan J. Emery

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

► SCHEDULE

.....
January 8, Friday

8:00 - 18:00 **REGISTRATION**

8:30 - 10:30 **REGULAR SYMPOSIUM 2**

Exploring the development and scope of over-imitation

10:30 - 11:00 **COFFEE BREAK**

11:00 - 13:00 **REGULAR SYMPOSIUM 3**

Representing power relationships in infancy and childhood

13:00 - 14:00 **LUNCH**

14:00 - 16:00 **INVITED SYMPOSIUM**

The development of explanatory reasoning: Biological, cognitive, and social processes
 Andrei Cimpian

16:00 - 18:00 **POSTER SESSION B** (with coffee & snacks)

18:00 - 19:30 **PAPER SESSION 2** Representing and evaluating agents

.....
January 9, Saturday

8:00 - 18:00 **REGISTRATION**

8:30 - 9:45 **INVITED LECTURE 2**

Early expectations about ingroup support
 Renée Baillargeon

9:45 - 10:15 **COFFEE BREAK**

10:15 - 12:15 **REGULAR SYMPOSIUM 4**

The origins and development of cumulative culture

12:15 - 13:15 **LUNCH**

13:15 - 15:15 **PAPER SESSION 3** Word learning

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

17:15 - 19:15 **REGULAR SYMPOSIUM 5**

Are children effective active learners?

20.00 **GALA DINNER**



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INVITED
LECTURES

IL1

Nathan J. Emery

Queen Mary, University of London, UK

A birds' eye view of human cognition

Fifteen years ago, the suggestion that birds could present a serious model for human cognition would have produced much hilarity and derision as bereft the derogatory term 'birdbrain'. However, studies on a number of birds groups, especially corvids and parrots, have caused comparative psychologists (and the lay public) to re-think the possibility and potential of avian minds. Two significant events influenced this change in opinions – a re-assessment of the neural architecture of the avian brain, and studies revealing striking similarities between corvid and ape cognition that may be the result of convergent or independent evolutionary forces. In this lecture, I will review the progress that has been made since these two findings, assess whether they have stood up to their early claims, the species we should focus on next and why, and make a few suggestions as to where studies of avian brain, mind and behavior might go in the future.

IL2

Renée Baillargeon

University of Illinois, Urbana-Champaign, USA

Early expectations about ingroup support

What sociomoral principles guide early expectations about interactions among individuals? My talk will focus on the candidate principle of ingroup support and its two corollaries of ingroup love and ingroup loyalty. Proponents of this principle assume that early-emerging expectations about actions that facilitate group cooperation and survival developed over evolutionary time. In our experiments, infants and toddlers watch third-party interactions among unfamiliar individuals from novel groups; following the minimal-group method, groups are identified using salient markers (e.g., novel labels or outfits). Of interest is whether children hold different expectations for interactions between individuals from the same group as opposed to interactions between individuals from different groups. With respect to ingroup love, our results indicate that infants and toddlers expect individuals (a) to provide help and comfort to ingroup members in need and (b) to limit negative actions toward ingroup members. With respect to ingroup loyalty, infants and toddlers expect individuals (a) to prefer and align with ingroup members, (b) to favor ingroup members when distributing scarce resources, and (c) to co-retaliate against outgroup aggressors. Rich and abstract expectations about ingroup support thus emerge early in development.



INVITED
SYMPOSIUM

IS

THE DEVELOPMENT OF EXPLANATORY REASONING: BIOLOGICAL, COGNITIVE, AND SOCIAL PROCESSES

Organizer:

Andrei Cimpian, University of Illinois, Urbana-Champaign, USA

Speakers:

Giorgio Vallortigara, Centre for Mind/Brain Sciences, University of Trento, Italy

Andrei Cimpian, University of Illinois, Urbana-Champaign, USA

Katherine Kinzler, Cornell University, USA

Elizabeth Bonawitz, Rutgers University, Newark, USA

A considerable chunk of our mental lives is spent trying to make sense of the world. Even young children are brimming with “why?” questions about everything from the smallest event [e.g., why did the toy break?] to all-encompassing regularities [e.g., why are some people rich and others poor?]. This should come as no surprise, as our actions are informed by explanations in virtually all aspects of life: when we interact with others [e.g., why is this person behaving oddly?], when we do our jobs [e.g., why did the undergraduates do poorly on the quiz?], when we plan our finances [e.g., why are interest rates low?], when we assign blame [e.g., why did the cookies burn?], and so on. Since spontaneous explanations form the basis for much of what we do, investigating the process by which people generate these judgments is a crucial task for cognitive psychologists and developmentalists.

Yet, despite the central place of this process in human experience, much contemporary research on explanation has focused on explanation as a cognitive *product* rather than on explanation as a cognitive *process*. Influenced in part by the rich tradition of philosophical research on this topic, psychologists have often sought to identify what properties explanations must have in order to do their explanatory work [e.g., they must include mention of a cause] but have paid less attention to how people might come about an explanation in the first place—to the *process* by which explanations that embody these desirable properties are generated. The talks in this symposium make headway on this important issue, providing new insights into the biological, cognitive, and social processes that enable people to generate explanations across development.

The first talk [Vallortigara] provides a comparative perspective on this topic by describing some of the basic biological machinery that enables animals to make sense of their social world. The second talk [Cimpian] suggests that explanations are often generated heuristically; children and adults alike use easily-retrieved information to

assemble simple, approximate answers to the complex “why?” questions that arise in everyday life. The third talk [Kinzler, Liberman, Dautel, & Woodward] demonstrates that information about people’s language and accent influences how children make sense of others’ social identities, relationships, and shared properties. The fourth talk [Bonawitz] highlights the role of social information in guiding young children’s explanations, with a particular focus on the link between the type and number of questions asked of children and their explanatory output. Together, these talks advance theory on the processes underlying the development of explanatory reasoning and suggest new directions for empirical work on this important, but underresearched, topic.

IS-01**Making sense of the social world: Biological predispositions to detect living things in newborn animals' nervous systems**
.....**Giorgio Vallortigara**Centre for Mind/Brain Sciences, University of Trento, Italy
.....

We investigated whether speed changes affecting humans' animacy ratings elicit spontaneous social preferences in visually-naïve chicks. Chicks were tested for their preference for approaching an object moving at a constant speed and trajectory or an identical object, which suddenly accelerated and then decelerated again to the original speed. Chicks showed a significant preference for the "speed-change stimulus". Matching the variability of the control stimulus to that of the "speed-change stimulus" did not alter chicks' preference for the latter. Chicks' preference was instead suppressed by adding two occluders on both stimuli, positioned along the object trajectory in such a way to occlude the moment of speed change. Thus, for chicks to show a preference, the moments of speed change need to be visible. To study the neuronal basis of this predisposition, we exposed two groups of visually naïve chicks to either one of the two stimuli and visualized brain activity by an immunohistochemical staining of the immediate early gene product *c-Fos*. We found a differential involvement of the right septum between the two groups. The septal nuclei are an evolutionarily well-conserved part of the limbic system, present in all vertebrate groups, and they are usually considered as a key node of the social behaviour network. Our results suggest the involvement of these social brain areas in processing of elementary visual cues of animacy.

IS-02**Explanation as a heuristic cognitive process: The inherence heuristic across development**
.....**Andrei Cimpian**University of Illinois, Urbana-Champaign, USA
.....

How do people generate explanations? Finding the correct explanation for most everyday facts – even the most mundane [e.g., people eat eggs for breakfast] – requires that we access and integrate a considerable amount of information. However, people seldom have access to all relevant information [e.g., patterns of covariation between all candidate causes and the observation to be explained]; even if they did, it would often be computationally prohibitive to sift through these data in order to rationally construct an explanation. Thus, I propose that, in everyday life, people tend to come up with explanations much as they come up with solutions to other complex problems – *heuristically*. Extensive research on judgment and decision making suggests that people routinely answer difficult questions by using whatever information they can retrieve easily to construct a simple, approximate answer. Prompts for an explanation [e.g., why do we eat eggs for breakfast?] are hypothesized to trigger a similar process. This process oversamples highly accessible facts about the entities in the observation to be explained. Due to the organization of memory, these accessible facts are more often about the inherent features of the relevant entities [e.g., eggs have a lot of protein] than about their history, their relations to other entities, etc. This bias toward inherence is then reflected in the final product of this heuristic process [hence the name *inherence heuristic*]. A series of experiments illustrate the developmental course of this explanatory heuristic and its pervasive effect on how children and adults make sense of the world.

IS-03**Children's explanatory reasoning about language as a social category**

Katherine Kinzler¹, Zoe Liberman², Jocelyn Dautel³,
Amanda Woodward²

¹ Cornell University, USA

² University of Chicago, USA

³ Queen's University Belfast, UK

Infants and children express social preferences for novel individuals based on their social group membership. But for a young child, beyond preferences for the familiar, what constitutes a social category? What types of information mark social kinds for children, and what kinds of evidence should we as researchers take as indications of children's social categorization? Here I provide evidence that people's language – and their accent in particular – is one type of information that guides children's thinking about others as being members of a shared social category. In a first series of studies, 5- to 6-year-old children predicted that social relationships would occur between individuals who spoke with a common accent, even if those people could not communicate effectively (e.g., if one used unconventional semantic meaning or grammatical structures). A second series of studies provides evidence that the tendency to view language as indicating the status of third-party social relationships begins in infancy: infants anticipated that speakers of the same language, but not of two different languages, would share a positive social relationship. In ongoing research, we find that language also guides children's inferences about an individual's identity over time, as well as the biological properties people share. Furthermore, learning that people are native versus foreign speakers constrains the kinds of information that infants generalize across people. Taken together, this research shows that language influences infants' and children's reasoning about other people's social identities, relationships, and shared properties, providing evidence of children's explanatory reasoning about language as a social category.

IS-04**Beyond the data: How social inferences shape preschoolers' explanatory reasoning**

Elizabeth Bonawitz

Rutgers University, Newark, USA

Burgeoning evidence suggests that when children observe data, they use knowledge of the demonstrator's intent to augment learning. I propose that the effects of social learning may go beyond cases where children observe data, to cases where they receive no new information at all. I present an analysis of how simply asking a question a second time may lead to explanatory revision (at least in cases when the questioner is expected to know the correct answer). I then present three experiments investigating 4- and 5-year-old children's reactions to neutral follow-up questions posed by ignorant or knowledgeable questioners. Children were more likely to change their answers in response to a neutral follow-up question from a knowledgeable questioner than an ignorant one. I discuss the results in the context of common practices in legal, educational, and experimental psychological settings – with particular focus on how this social information can guide the explanations of young children.



REGULAR
SYMPOSIA

RS1**DEVELOPMENT AND EVOLUTION
OF MEMORY AND PLANNING**

Organizer:

Amanda M. Seed, University of St Andrews, UK**James A. Ainge**, University of St Andrews, UK

Episodic memory and episodic future thinking, the ability to re-experience the past and pre-experience the future respectively, are key abilities in the human cognitive repertoire. It has been suggested that these processes are supported by a common underlying cognitive mechanism; mental time travel. Neuroimaging studies are broadly supportive of this hypothesis demonstrating a strong correlation in the networks supporting both memory and planning. An interesting way to further test this theory would be to examine how these processes emerge in development and across species. Do they develop in tandem in childhood, or does one precede the other? Are good rememberers good planners? However, the status of episodic cognition in preschoolers and nonhuman animals is hotly debated, with some arguing that it is not possible for non-human animals and young children to mentally travel in time. One clearly outstanding issue that is acknowledged is that the field lacks good tests for episodic cognition that are not confounded by verbal demands, or species-specific adaptations, such as food caching. This symposium aims to discuss some of the questions surrounding the onset of episodic cognition both in human development and evolutionary history. The speakers in this symposium have all developed new empirical tests for these groups: each talk presents data from different methods that allow for meaningful comparisons across species, development, and psychological ability.

Vlter et al. present a comparative study on short-term planning capabilities. Using a vertical maze task, the experimenters found that apes and children planned similarly but each encountered unique difficulties within the experimental framework. Dickerson et al present a developmental study of memory and planning in children and ask whether or not these skills rely on overlapping mechanisms. Using verbal and non verbal measures, she presents evidence that memory and planning can be disambiguated in children between the ages of 4 and 7. Osvath et al. also use multiple experimental techniques to show converging evidence for flexible episodic planning in ravens. Finally, Bryant et al discuss work on non-verbal tests of episodic cognition in children and primates with a non-verbal task adapted from rodent studies.

Ultimately, data from these four presentations will start a conversation about the important questions facing the episodic cognition research community. By bringing together comparative and developmental perspectives, this symposium is aimed at encouraging an integration of methods across these disciplines, where traditionally a divergence of methodology has thwarted comparison.

RS1-01**Action planning and causal inference in great apes and preschool children**

Christoph J. Valter, Josep Call

Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany

Planning defined as the predetermination of a sequence of actions towards some goal is crucial for complex problem solving. To examine the ontogenetic and phylogenetic roots of action planning, we presented nonhuman great apes as well as 4- and 5-year-old preschoolers with a vertical maze task. Apes and children could gain a reward placed on the uppermost level by moving it to the bottom through open gaps situated at each level of the maze. In every trial, three of ten gaps were blocked by trap elements. Like in a decision tree, participants could make mistakes already on the uppermost level even though traps were located only in subsequent levels. Therefore, depending on the trap configuration, apes and children had to plan their actions multiple steps ahead.

We found that [1] younger apes as well as 5-year-old children planned their moves up to two steps ahead whereas 4-year-olds were limited to plan one step ahead, and [2] similar performance but different underlying limitations between apes and children. Namely, while all species of nonhuman apes were limited by a lack of motor control, human children exhibited a shortage in shifting their attention across a sequence of subgoals. In follow-up studies, naïve apes and 4-year-olds failed to solve the maze task when they received only color cues (instead of functional information) signalling the location of the traps. Overall, our findings suggest that younger apes and preschoolers spontaneously plan their moves ahead while taking advantage of causally relevant information about the maze's dead ends.

RS1-02**Exploring relationships between episodic memory, future thinking and scene construction in children**

Katherine L. Dickerson, Emmie L. F. Bryant, James A. Ainge, Amanda M. Seed

University of St Andrews, UK

The ability to mentally recreate past experiences and the ability to imagine future episodes are intimately connected in adults by a common network of brain regions, (Addis, 2007). The explanation for this link at a cognitive level is debated, but one popular notion is that both draw upon the cognitive skill of 'scene construction' (Hassabis, 2007). In order to explore this hypothesis we looked at individual differences in imagination, memory and planning over child development. This was done through a test battery including both interview techniques and experimental tests of memory and planning (versions of the so-called 'spoon test' [Suddendorf, 2005; Atance, 2013]). Differences were evaluated both within individuals and across development through an analysis of children between four and seven years of age. In the interviews subjects were instructed to remember or create a scene based on word prompts. Each interview was transcribed and coded based on the guidelines given by Hassabis, Kumaran and Maguire [2007] with modifications to allow for the decreased age of participants. Across all three conditions scores improved incrementally with age. Within this age group, the ability to construct rich scenes appears diminished in the future as compared to the past tense. A behavioural task aimed at determining future thinking capabilities is included to determine whether this new verbal methodology is testing the same psychological mechanism as forced-choice tasks, which are more commonly used in this age group. A correct choice on this task was correlated with higher performance during the interview assessment.

RS1-03**Ravens plan for future bartering with a human, as well as for future tool use – indicating a flexible episodic system**

Mathias Osvath, Can Kabadayi

University of Lund, Sweden

It has been shown that corvids seem to be able to relate to the past and the future in an episodic-like way: flexibly integrating several information elements into coherent and seemingly purposeful actions; elements such as when, where and what. Great apes too have revealed such memory and planning. In humans, such performances, both in memory and planning, are associated with the episodic system. The phylogenetic proximity between apes and humans suggests that the ape behaviours result from an overlapping episodic system. However, mammals and birds share a last common ancestor 320 mya. Even if birds have a well-developed hippocampus – an essential neuro-structure for the episodic system – we know very little of its function in complex behaviours. The previous corvid studies have been criticized for only measuring memory and planning within the caching context. As most corvids are habitual cachers they may have evolved flexibility in memory and planning only within the caching context – such domain specific functions would differ from the human episodic system. Therefore we investigated whether ravens (*Corvus corax*) show flexible planning skills outside the caching paradigm. Two main conditions were chosen based on their ecological invalidity, to avoid evolved propensities: [1] planning for future bartering with a human; and [2] planning for future tool-use. The results show that the ravens are much capable of solving these tasks – even exerting self-control –, as good as, or better than, great apes. This indicates that at least corvids have parallelly evolved a truly flexible episodic system.

RS1-04**What do tests of episodic cognition test? A study with pre-school children and non-human primates**Emmie L. F. Bryant, Katherine L. Dickerson,
Amanda M. Seed, James A. Ainge

University of St Andrews, UK

Episodic cognition, the ability to remember the past and imagine the future, has been described as a late-developing, uniquely human trait. As language is a great limitation to identifying episodic cognition in young children and non-human animals, non-verbal tests have been designed to challenge this claim. However, many of these rely on species-specific behaviours that are difficult to elicit from other groups of interest. We modified a content-integration task based on novel object recognition (what-where-which) to test pre-school children and non-human primates. We also implemented an experience recollection task (the spoon test) as a point of comparison, to determine to what extent these different but widely-used approaches tap into the same cognitive processes. We tested 63 children aged 4-7, with the intention of identifying age-related changes in task performance and if these changes were related across both task types. Performance differed significantly across conditions of the content-integration task, but there were no effects of age. Performance also did not differ significantly with age on the spoon test, although in every age group most children were able to solve the task correctly. It was found that spoon test performance did predict performance on the content-integration task, but not in the “episodic” condition. We will discuss what the implications of this are for the standards to which we hold non-human, non-adult test subjects and the criteria we enforce in standard tests of episodic memory. Preliminary results from a study utilizing the same paradigm with brown capuchins (*Sapajus apella*) are presented.

RS2**EXPLORING THE DEVELOPMENT
AND SCOPE OF OVER-IMITATION**

Organizers:

Andrew Whiten, University of St Andrews, UK
Nicola McGuigan, Heriot-Watt University, UK

Discussant:

Stefanie Keupp, German Primate Center, and University of Göttingen, Germany

Over-imitation, a tendency to copy even visibly causally-irrelevant aspects of actions, was first documented in children ten years ago and only named in 2007, yet has become the subject of a substantial and growing corpus of research studies probing its nature, significance and occurrence. Initially thought a puzzling and apparently maladaptive response in young children, it has now been identified in several quite different cultures, with a single exception [Berl et al., 2015], and instead of dissipating with cognitive development, it has been found to become stronger, even into adulthood. Comparative studies suggest it is lacking in even our closest primate relatives. Accordingly, attention has shifted to seeking adaptive explanations for the phenomenon. Early studies, notably by Lyons et al. [2007], interpreted it as a means to acquire appropriate manipulative techniques for the enormous array of causally-opaque human tools and other artefacts. With time alternative theories have developed, several of which instead propose social functions, from facilitating social bonding to learning conventions, norms and rituals. These theories are further explored in this symposium.

The four talks illustrate the variety in methodological approaches developing in the field, and a substantial range of developmental stages. Thus the first [Buttelmann and Gellén] traces development from 18 months to 3 years of age using comparable tests. The infants are discriminating, copying unusual and unnecessary non-manual actions on objects, according to whether these are freely chosen [hands free] or not [hands occupied], whereas older children are progressively prone to [over] imitate more unconditionally. However, analysis of gaze suggests that the strengthening imitative response might be due to children's growing desire to affiliate with the model. The influence of social context is picked up by McGuigan and Robertson but with a focus on peers. This paper reports that if young children see both efficient and more inefficient manipulative techniques modeled by different children, they opt to replicate the efficient option irrespective of the social context of one peer remaining present and the other departing. However, if the inefficient actions are modelled by several peers, children

are then more influenced to incorporate them. The paper by Hoehl et al. links directly to this in also incorporating conditions displaying both inefficient and efficient alternative approaches but examines complementary factors affecting selective copying, including the effects of communication, pedagogy and group membership. Young children were found initially not to require pedagogical communication to display overimitation of inefficient actions, yet for switching from an originally learned ineffective to an effective option, such communication became important. The final paper by Whiten et al. offers a counterpoint, showing that in a naturalistic context, overimitation may appear in both children and adults without any possibility of social interactions. Together, these four studies dissect a range of social factors moderating the over-imitative responses of young children, confirming the power of the phenomenon in several contexts but also progressively revealing its adaptive flexibility.

RS2-01**The development of over-imitation during early childhood**

David Buttelmann^{1,2}, Kata Gellén¹¹University of Erfurt, Germany²University of Bern, Switzerland

Cultural learning plays a crucial role in enabling children to fit into their social community by mastering culture-specific habits. Whereas infants seem to be sensitive to a model's situational constraints, older children may "over-imitate" by copying actions irrespective of the model's constraints. We investigated this change in cultural learning in the early preschool years. Eighteen-, 24-, and 36-month-olds ($N = 293$) observed two unusual actions on novel apparatuses: instead of using her hand, a model operated an apparatus by using her head or by sitting on it. She did so once with her hands being occupied, and once with her hands being free. Using the same tasks across all age groups enabled direct comparison of their imitative performances. The applied within-subjects design revealed whether preschoolers alter their behavior based on rational evaluations of the model's observable constraints. Additionally, we analyzed the gaze directed at the model during the response phase of the participants of the current study and of 14-month-olds ($N = 82$) from Gellén and Buttelmann [2015]. Increasing age was accompanied by an increasing rate of overall imitation across conditions. Only 18-month-olds imitated unusual actions more often in the hands-free than in hands-occupied condition [see Gergely, Bekkering, & Király, 2002]. Furthermore, while 14-month-olds directed their gaze at the model after they re-enacted the observed target action only at chance, the three older age groups did so at above chance. The change in gaze behavior and children's imitative response patterns point towards the emergence of an underlying social component in the ontogeny of imitation.

RS2-02**The influence of peers and conformity on overimitation in 3- and 4-year-old children**

Nicola McGuigan, Stacey Robertson

Heriot Watt University, UK

Human children have frequently been shown to be high-fidelity imitators who faithfully reproduce the actions performed by a model. Curiously, children do not always appear to copy actions rationally and often copy in situations where doing so will lead to a reduction in task efficiency. This over-imitative tendency has been explored extensively with respect to adult models, but we know very little of the influence that peers can have on the fidelity of copying behavior. In an initial experiment, 3- and 4-year-old children watched two peers retrieve a reward from a puzzle box using a sequence of actions that were either causally relevant or causally irrelevant to reward retrieval. On completion of the task demonstrations, one model left the testing room, leaving the children to perform the task in the presence of the remaining efficient or inefficient peer. The results showed that, rather than copying the strategy of the peer who was physically present, the children displayed "blanket efficiency" and rarely reproduced the causally irrelevant actions. Intriguingly, the children switched from their previously efficient behavior when they were exposed to additional peer models who performed the causally irrelevant actions. The switch to an inefficient approach appeared to result from normative conformity because the children failed to reproduce the causally irrelevant actions when allowed to perform the task one final time in private. We suggest that the influence of the majority, although detrimental to task efficiency in this case, is a key cornerstone of human cultural evolution.

RS2-03**The effect of social group membership on over-imitation**

Stefanie Hoehl, Hanna Schleihauf, Sabina Pauen
Heidelberg University, Germany

Children and adults tend to imitate actions that include those irrelevant to accomplishing a goal. It is debated whether erroneous causal reasoning or social motivations (e.g., social norm learning, affiliation) underlie such over-imitation (e.g., Lyons et al., 2011; Nielsen & Blank, 2011). Yet children have also been shown to selectively imitate the actions of in-group members (e.g., Buttelmann et al., 2013), a potential paradox. Here we test the effects of social motivations on over-imitation by manipulating group membership of children and models using a minimal group design. In each experiment children observe two adult models retrieve a reward from a transparent puzzle-box: the first model uses causally irrelevant and relevant actions, the second model uses only causally relevant actions. After each demonstration, children extract a reward themselves, with causally irrelevant actions providing a measure of over-imitation. Five-year-olds ($N = 28$) switched from an inefficient strategy including irrelevant actions to the efficient strategy when both experimenters were communicative and no group membership was assigned, suggesting that children are able to flexibly deploy multiple strategies. In a current follow-up experiment, the results of which will be reported, the first model belongs to the same group as the child and the second model belongs to an out-group. If over-imitation is socially motivated we predict that children will selectively copy the in-group member, continuing to perform irrelevant actions even after seeing the efficient strategy performed by an out-group member. Based on causal reasoning alone children should switch to the efficient strategy regardless of group membership.

RS2-04**Over-imitation occurs in a naturalistic context in children and adults without social interaction**

Andrew Whiten, Siobahn Devlin, Natalie Kseib
University of St Andrews, UK

This study avoided the traditional experimental, laboratory context in which over-imitation is typically examined, instead aiming to determine whether over-imitation – the disposition to copy even visibly, causally unnecessary actions – occurs in a real-world context. We disguised a puzzle-box task as an interactive item available to the public within a science engagement zone of Edinburgh Zoo. As a child or adult member of the public approached the puzzle-box a confederate acting as a zoo visitor, retrieved a reward from the box using a sequence of actions containing both causally relevant and irrelevant elements. Despite the absence of intentional demonstration, or social pressure to copy, a majority of both child and adult observers included all causally irrelevant actions in their reproduction. This occurred even though causal irrelevance appeared manifest because of the transparency of the puzzle-box. That over-imitation occurred so readily in a naturalistic context suggests that humans are opportunistic social learners, who copy the actions of other individuals even when these actions are not intentionally demonstrated, and even when their causal significance is not readily apparent. This capacity to copy precisely as a mere onlooker likely provides humans with a powerful mechanism with which to extract maximum information from the social environment.

RS3**REPRESENTING POWER RELATIONSHIPS
IN INFANCY AND CHILDHOOD**

Organizers:

Maayan Stavans, University of Illinois, Urbana-Champaign, USA

In order to navigate successfully through the social world, it is important to be able to identify power asymmetries in social interactions and to understand the consequences of these asymmetries for ourselves and others. Recent research has begun to explore the emergence and development of these abilities in infancy and childhood. This symposium built on these efforts and examined sensitivity to two different types of power asymmetries in infants and young children.

The first two presentations focused on power relations in a competitive situation, where a dominant individual prevailed over a subordinate individual in obtaining a goal. Using an eye tracker, the first presentation examined whether 18- and 21-month-olds would anticipate that an object would appear where the dominant individual expected it to appear as opposed to where the subordinate individual expected it to appear. Results indicated that the older infants (but not the younger infants) aligned their anticipatory responses with those of the dominant individual. In the second presentation, preschoolers and 8-year-olds were asked to divide resources unequally between the dominant and subordinate individuals. Results indicated that the younger children favored the dominant individual whereas the older children favored the subordinate individual, giving rise to important questions about the causes of this developmental shift.

The next two presentations focused on power relations in a non-competitive situation, where a leader or authority figure held sway over subordinate members. The third presentation included two projects on infants' expectations about the specific responsibilities of leaders toward their subordinate members. Both projects used the violation-of-expectation method and presented infants with live interactions among a group of puppets. In one project, 17-month-olds expected the leader (identified by its larger size) to intervene when a transgression was committed by one subordinate member towards another. In the other project, 22-month-olds expected the leader (identified by the subordinates' compliance with its instructions) to fairly regulate access to a scarce resource among the subordinate members. In both projects, infants held no expectations when the leader was replaced by another subordinate member. Finally, the last presentation examined what types of cues 3- to 4-year-olds could use to identify the "person in charge" in photographs depicting social scenes. Children were able to use differences in age, size,

vertical position [e.g., a person standing on a block vs. on the ground], and posture [e.g., expansive vs. hunched] to determine who was in charge in the scenes; however, they failed to use more subtle cues such as head position, eyebrow position, or gaze.

The four presentations in this symposium will thus report on developmental research conducted using a variety of ages and methods, but all focusing on asymmetrical power relations. The findings presented should help us better understand how children construe different types of power asymmetries; what cues signal these asymmetries; what consequences these asymmetries have for children's own actions as well as for their expectations concerning the actions of others; and how these abilities change with age and experience.

RS3-01**Influence of social dominance on learning**

Jesús Bas, Núria Sebastián-Gallés

Universitat Pompeu Fabra, Barcelona, Spain

Infants and children often receive new conflicting knowledge from different adults. Infants use several cues to determine the most reliable informant, such as past accuracy (Harris & Corriveau, 2011), prestige (Chudek et al., 2011) or in-group membership (Buttelmann et al., 2013). Here we study if dominance status is a cue that helps infants choose the informant.

The procedure consisted in three parts. In the first part, a video showed two female agents competing for the same goal. The same dominant one always prevailed. In the second part, trials consisted in the face of one of the agents appearing in the centre of the screen followed by the sound of an animal (sheep/cat for one agent and cow/cat for the other agent). Then the agent looked at one of the corners of the screen and the corresponding animal appeared. (similar to Tummeltshammer et al., 2014). Critically, one of the animals (the cat) appeared in different locations depending on the agent. In the third (test) phase, only the sounds and the pictures of the animals appeared. The analysis of the eye movements of 18- and 21-month olds showed that only older infants, when presented with the conflicting sound (the cat) preferred to look where the dominant agent did.

The results show that towards the end of the second year of life, children can use information about dominance status to guide their learning.

RS3-02**Children's representations and resource allocations in social dominance situations**

Rawan Charafeddine ¹, Hugo Mercier ², Fabrice Clément ²,
Laurence Kaufmann ³, Anne Reboul ¹,
Jean-Baptiste Van der Henst ¹¹ CNRS, Laboratoire Langage, Cerveau et Cognition (L2C2), Université Lyon 1, France² Neuchâtel University, Cognitive Science Center, Neuchâtel, Switzerland³ Lausanne University, Institute of Social Sciences, Lausanne, Switzerland

Recent research has demonstrated the complexity of children's and infants' representations of dominance relationships. Building on this research, we first present a series of studies showing that preschoolers can infer dominance from various cues related to asymmetrical interactions, such as physical fights or conflicts in decisions, and with characteristics of the interacting individuals such as age, possession of resources, body posture, and gender. We also show that preschoolers make inferences about the individuals involved in a dominance interaction.

The second part of this presentation discusses how these inferences guide children's behavior, in particular their resource allocation in third party dominance situations. We used a distributive justice paradigm to investigate whether children are more likely to favor a dominant or a subordinate, and how their actions change as they grow older. We conducted this study with preschoolers and 8-year-old children. After observing a dominant imposing his choice on a subordinate, children were asked to allocate an unequal amount of resources between the two individuals. We found a robust developmental pattern with preschoolers favoring the dominant and 8-year-olds favoring the subordinate. We argue that the tendency to favor the subordinate develops with the emergence of principled moral action around five years of age.

RS3-03**Infants view leaders as having specific responsibilities toward ingroup members**

Maayan Stavans, Renée Baillargeon

University of Illinois, Urbana-Champaign, USA

Prior research indicates that infants in the second year of life use a variety of cues (e.g., physical size, gaining control of a territory) to determine who has more power in a dyadic interaction. Here we examined interactions within a social group and asked whether infants held expectations about how the group's leader would behave toward subordinate members.

In two projects, infants watched live interactions among a group of puppets. The leader was marked either by its larger size (Project 1) or by the subordinates' compliance with its instructions (Project 2).

Project 1 examined whether 17-month-olds would expect the leader to intervene when a transgression was committed by one subordinate member towards another. Infants detected a violation when the leader ignored as opposed to rectified this transgression, and this effect was eliminated if the leader was replaced by another subordinate member.

Project 2 examined whether 22-month-olds would expect the leader to regulate access to a scarce resource (an attractive toy) among subordinate members. Infants detected a violation when the leader handed the toy to a subordinate who had already played with it rather than to a subordinate who had not. This effect was eliminated if the leader was replaced by another subordinate member.

Together, our results indicate that infants hold differential expectations about the behaviors of the leader and the subordinate members of a social group. In particular, infants view rectifying transgressions and regulating access to limited resources as the specific responsibilities of the leader of the group.

RS3-04**Young children's use of nonverbal information to make inferences about social power**

Elizabeth Brey, Rachel King, Kristin Shutts

University of Wisconsin, Madison, USA

Power differences between humans are often marked and manifested by differences in body position. While older children and adults are adept at exploiting "body language" to understand human social hierarchies, young preschool-age children have difficulty using these same cues. Study 1 of the present research tested whether 3-4-year-olds' poor performance might stem from a failure to spontaneously attend to the relevant information: A group of 48 3-4-year-old children viewed photographs featuring four kinds of cues to power: posture (expansive vs. hunched); head position (tilted up vs. down); gaze (forward vs. down); and eyebrows (lowered vs. raised). In each display, the cues were circled and participants were told where to look; then, participants were asked to point to the person who was "in charge." Children performed above chance only on posture trials (and performed at chance for all other cues). Study 2 tested whether 3-4-year-old children would show sensitivity to social power differences if presented with different cues to power. In Study 2, 48 3-4-year-old children viewed displays featuring differences in size (large vs. small), age (adult vs. child), and vertical position (a person standing up on a block vs. a person standing on the ground) and were asked who was "in charge." Participants performed above chance for all three display types. Taken together, these data suggest that some power cues (e.g., size) may be more primary or fundamental than others (e.g., head position) for humans.

RS4**THE ORIGINS AND DEVELOPMENT
OF CUMULATIVE CULTURE**

Organizers:

Zanna Clay, University of Birmingham, UK

Eva Reindl, University of Birmingham, UK

Claudio Tennie, University of Birmingham, UK

A key chasm separating humans from other animals is the capacity to produce cumulative culture, i.e. to gradually accumulate improvements in cultural products over time (the ‘ratchet effect’; Tennie, Call & Tomasello, 2009; Tomasello, 1999). As an emerging field, most experimental research on cumulative culture has been conducted on human adults [Caldwell & Millen, 2008]. Nevertheless, research into the ontogeny of cumulative culture provides important insights into the underlying cognitive mechanisms. In addition, comparative research into the skills of our closest living primate relatives provides complementary insights into the cognitive mechanisms constraining the evolutionary emergence of cumulative culture [Dean et al., 2012]. In this symposium, we aim to provide a state-of-the art overview of current advances in research into the ontogenetic and phylogenetic emergence of cumulative culture.

The ontogenetic and phylogenetic emergence of cumulative culture is considered to rest on two key cognitive skills: high-fidelity transmission and innovation [Boyd & Richerson, 1996; Lewis & Laland, 2012]. Although children are known to be expert copiers, it is not yet understood at what age children become able to copy cumulative culture and whether they can produce it themselves. To address this, Reindl will present work examining the age at which children become able to copy cumulative culture and what social information they require to do so. To extend this question, Caldwell will present studies examining the flexible use of social information by children during cumulative cultural tasks. Being able to use social information – an essential component of cumulative culture – requires a certain degree of perspective-taking. Caldwell addresses this by presenting experimental evidence of the relationship between perspective-taking and cumulative cultural performance in 3-5 year-old children.

Compared to high-fidelity learning, even less is known about the innovative aspect of cumulative culture. For instance, the extent to which innovation can be facilitated by social learning is largely unexplored. In this symposium, Price will present research examining children’s ability to make tools to solve a novel problem after having been presented with differing amounts of social information.

With regard to cumulative culture in non-humans, a central debate is whether the ‘ratchet effect’ is restricted to humans or if it is also found in other species. Whereas some researchers argue that non-human great apes are capable of producing cumulative culture [de Waal, 2012; Whiten, 2011], others say they are not [Tennie et al., 2009]. To address this, Tennie will present the *Zone of Latent Solutions* theory as an explanation of non-human culture and the potential absence of cumulative culture in non-humans. Clay will then present complementary data on the copying abilities of human children compared to bonobos, our little understood ape relatives. The data indicate that, among great apes, novel action copying in the absence of physical information, a building block of cumulative culture, appears to be uniquely human. Kendal will present empirical evidence from comparative studies of children and great apes showing humans’ proficiency in producing cumulative culture. Kendal will also discuss the role of transmission biases in the production of cumulative culture.

RS4-01**The social transmission of culture –
developmental and comparative perspectives**

Zanna Clay, Eva Reindl, Claudio Tennie

University of Birmingham, UK

It has been argued that cumulative culture is a uniquely human phenomenon. Here, we present the *Zone of Latent Solutions* (ZLS) hypothesis, which provides the theoretical framework to demonstrate why cumulative culture is special in humans compared to genetically-fuelled cultural behaviours in non-human animals. Cumulative culture requires high fidelity copying and it has been argued that imitation- or 'action copying'- can provide such fidelity. Not only do humans – the only species clearly producing cumulative culture – copy actions frequently, they also do so from a very young age. In contrast, non-human great apes (apes) do not typically copy actions; instead their cultures are constrained by their ZLS. Here, we discuss the implications of the ZLS concept for both developmental and comparative psychology and argue that, compared to apes, human cultures expand via our zone of proximate development (ZPD). We provide experimental evidence of some core differences between humans and apes by showing that novel action copying in the absence of physical information – a building block of cumulative culture – is already present in 3-5-year-old human children, but absent in bonobos. Finally, we present studies on the development of the ability to acquire cumulative culture in children. Using a construction task, we show that 4-5-year-olds benefit from both action and end-state demonstrations in order to go beyond what they could have achieved by themselves. Overall, we provide theoretical and empirical evidence that from a young age, humans fundamentally differ from apes in their abilities [and/or motivations] to engage in cumulative culture.

RS4-02**Flexibility in children's imitation**

Christine Caldwell, Eoin O'Sullivan

University of Stirling, UK

The human capacity for cumulative culture may depend on not only a propensity for social learning, but also the ability to use this information flexibly, inhibiting inappropriate or suboptimal responses in favour of more effective alternatives. In relation to this, we present data looking at automatic imitation effects in children aged 3-7 years old who were prompted to perform actions that were either compatible or incompatible with actions performed by the experimenter. We also consider the role of capacities for perspective-taking in relation to switching between alternative representations, and present preliminary data looking at this in 3-5 year old children in relation to performance of actions.

RS4-03

Does social learning from multiple sources scaffold innovative tool construction in children?

Elizabeth E. Price

Newcastle University, UK

Cumulative culture requires both the invention of novel traits (innovation) and the transmission of these traits between individuals (cultural transmission). Both innovation and cultural transmission have been investigated in children with regard to tool use, but the combination of these two abilities, namely the possibility that social learning might facilitate innovation, remains underexplored. Here, children were tested on their ability to modify a tool following a demonstration by one or two models, or in a baseline condition with no demonstration. Preliminary results suggest that children were able to combine two demonstrated techniques to construct a novel tool and retrieve a reward, outperforming children provided with no information. Furthermore, these children were equally and, in some cases, better able to solve the task than those provided with a complete demonstration of the solution (a model building the novel tool using both techniques). Results suggest that children may use their well-developed capacity for social learning to scaffold their less developed ability to innovate tools. The role of such combinative learning is discussed in relation to cumulative culture.

RS4-04

The role of transmission biases in cumulative culture

Rachel Kendal

Durham University, UK

Cumulative culture requires individuals to build upon the knowledge of previous generations such that trait complexity/efficiency evolves across generations. Such cumulative cultural evolution is arguably unique to humans and is widely held to be responsible for our outstanding success in colonising virtually every terrestrial habitat on the planet and solving countless ecological, social and technological challenges. In contrast, social learning (learning from others) underlies the wide-spread occurrence of traditions or culture in all animals. Although social learning is a cheap and efficient form of learning, it is not adaptive to use social information indiscriminately due to its potential unreliability. Thus it is predicted that transmission biases should evolve enabling individuals to avoid the costs associated with asocial learning and determine when they should use social information and from whom they should acquire it. I shall review several of my recent empirical studies, with young children and non-human primates, highlighting the potential role of social learning strategies, in humanity's striking capacity for cumulative culture.

RS5**ARE CHILDREN EFFECTIVE ACTIVE LEARNERS?**

Organizers:

Azzurra Ruggeri, Max Planck Institute for Human Development, Berlin, Germany
& University of California, Berkeley, USA

Discussant:

Elizabeth Bonawitz, Rutgers University, USA

Virtually all developmental psychology textbooks start with a set of enduring themes on the study of children's development, and almost every one of them lists "the active child" as one of the questions that have motivated and puzzled developmental psychologists over the decades. What does it mean for a child to be "an active learner"? Are young children efficient in their search for information, can they judge what information is most useful and how best to obtain it, or must they rely on others to constrain their learning environment through pedagogical instruction? While the role of adult teaching in infants' learning is undeniably crucial, some evidence suggests pedagogical instruction can in certain contexts constrain children's natural exploration to the extent of hindering their learning [Bonawitz et al., 2010]. In the proposed symposium, we focus on the young child as an active learner and explore how efficient young children are in selecting and seeking relevant information from people and environment in general, using eyetracking, neuroimaging techniques and behavioral experiments.

In the first talk, Ezgi Kayhan will present an eyetracking study demonstrating 14-month-old infants are efficient in distinguishing between relevant and irrelevant information, only updating their expectations if an event is predictive of subsequent events. In the second talk, Katarina Begus will present neuroimaging data demonstrating that 21-month-old infants, when given a choice between two informants, preferentially prepare to learn from the informant offering generalisable information over item-specific information. Finally, Azzurra Ruggeri will present results of a study exploring children's understanding of what constitutes a good question, showing that children are able to identify and select the questions that provide the highest information gain. Combined, these studies provide strong evidence that, across three ages, young children are efficient active learners, attending to, selecting and seeking the most useful information available.

Our discussant, Elizabeth Bonawitz, whose work centers on developing theories and formal models of learning that can account for the active way in which children learn, sample and explore the environment, will synthesize the presented findings, stimulate and lead the discussion.

RS5-01**Infants' dissociate between surprising events in the extent to which they are relevant for updating**

Ezgi Kayhan ¹, Sabine Hunnius ¹, Jill O'Reilly ², Harold Bekkering ¹

¹ Donders Institute for Brain, Cognition and Behavior, the Netherlands

² Functional MRI of the Brain Centre, Nuffield Department of Clinical Neurosciences, John Radcliffe Hospital, Oxford, UK

Infants' surprise responses have long been considered to reflect an internal model about how events should unfold. However, the link between infants' surprise and their expectations remains unclear. Using a saccadic planning paradigm, we investigated whether infants dissociate between surprising events in terms of their relevance for modulating an internal model.

Infants observed differently colored bees that appeared on one of the spots on a circle. In "surprise/update" trials, the location of the stimulus differed from the previous trials and remained the same in the subsequent trials. Thus, participants were expected to update their internal model about the location of the stimulus. In the "surprise/no-update" trials, another stimulus appeared at a different location on the circle for once. Here, the location of the stimulus was again surprising; however, as this was a one-time event, participants were expected to not change their internal model about the location of the following stimuli. In expected trials, the stimulus location remained unchanged.

Preliminary results from eighteen 14-month-olds demonstrated that participants learned whether a surprising event demands a change in their expectations or not. They were slower to look at the target on the "surprise/update" and "surprise/no-update" trials compared to the average of "expected" trials; however, there was no behavioral cost on the following trials. Preliminary data thus demonstrates that infants differentiate between surprising events based on whether they demand a tuning of an internal model or not. This finding implies that infants rely on the relevance of the surprising information to modulate their expectations.

RS5-02**Effective learning in infants: 21-month-olds prioritise encoding generic over specific information**

Katarina Begus, Teodora Gliga, Victoria Southgate

Centre for Brain and Cognitive Development, School of Psychology, Birkbeck, University of London, UK

In order to maximize the efficiency of learning, one should prioritise encoding information that can be generalized and applied in various contexts, over item-specific information. Research suggests that this bias is present early in development. Young children both process earlier (e.g. Hollander et al., 2002) as well as more accurately remember information that is generic (Cimpian & Erickson, 2012). Moreover, Cimpian and Park (2014) demonstrated that information about kinds is privileged in children's cognition not only by being better processed and remembered but also by being preferentially sought out.

With our study, we aimed to investigate whether this bias to prioritise encoding generalisable information is present even in infants. We familiarized 21-month-olds with 2 adults, one of whom was labeling novel animals using an article 'a' before a label and the other did not, creating the distinction between proper names and category labels. Infants at this age have been previously shown to understand this distinction and attach the label to a category when used with an article, and to a specific exemplar when used without (Belanger & Hall, 2006). Using a novel measure of theta oscillations (shown to predict encoding and to be modulated by motivation to learn (Begus et al., 2014; Gruber et al., 2013)), we demonstrated that infants at 21-months of age preferentially prepare to encode generalisable information over item-specific information ($t = 3.013, p = 0.009$). Concurrently recorded pupil dilation and looking-time data will also be presented, jointly demonstrating that infants are highly efficient and selective learners.

RS5-03

Five-year-old children can identify the most efficient questions

Azzurra Ruggeri ^{1,2}, Zi Lin Sim ², Fei Xu ²

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² University of California, Berkeley, USA

Asking questions is a powerful learning tool. We know that young children ask domain-appropriate questions, have reasonable expectations about which responses count as answers to their questions, and can use the answers they receive to solve problems. But do children know what a good question is? We provide some first evidence suggesting that 5-year-olds, despite not being able to generate effective questions for problem-solving (see Legare et al., 2013), are already able to successfully identify the most efficient among given questions iteratively.

In two sets of studies, children are presented with a storybook describing the reasons why Toma (a monster) was late to school over several days. In the first set of studies consisting of three experiments, we manipulated the number and likelihoods of the reasons presented. Children were then asked to identify which of two given questions will be more efficient in finding out why Toma was late to school again. In the second set of studies, we provided an answer to the children's chosen first question, and children were once again asked to identify the more efficient question under the newly constrained hypothesis space.

Overall, we find that children can iteratively identify the most efficient question successfully, that is, the question with higher information gain. Our findings also demonstrate that children's judgments were not based on simple heuristics, such as selecting the question with the highest probability of getting a YES answer or selecting the question that targets the most likely reason.



PAPER
SESSION 1
REASONING

PS1-01**The influence of power and reason on young Maya children's endorsement of testimony**

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¹ Cognitive Science Centre, University of Neuchâtel, Switzerland

² CNRS, L2C2, Lyon, France

³ Universidad de Costa Rica, Instituto de Investigaciones Psicológicas, San José, Costa Rica

Two important parenting strategies are to assert one's power and to use reasoning. The effect of these strategies on children's evaluation of testimony has received very little attention. Using the epistemic vigilance framework, we predict that when the reasoning cue is strong enough it should overcome the power cue: strong enough arguments from a subordinate should trump weak arguments from a dominant. We test this prediction in a population for which anthropological data suggest that power is the prominent strategy while reasoning is rarely relied on. When power and reasoning are presented independently, 4- to 6-year-old children from a traditional Maya community grant them equal weight in evaluating testimony (Experiment 1 and Experiment 2). However, when the cues conflict, so that the subordinate gives a strong argument while a dominant gives either a weak argument (Experiment 3) or no argument (Experiment 4), reasoning trumps power.

PS1-02**Foundations for the development of essentialist beliefs: The role of general explanatory processes**

Shelbie L. Sutherland, Andrei Cimpian

University of Illinois, Urbana-Champaign, USA

People believe that membership in natural and social kinds is a matter of possessing certain internal, microstructural "essences." This belief emerges early in development and shapes children's understanding of many aspects of the world [e.g., Gelman, 2003]. Yet, it is still unclear how such beliefs first develop. Here, we propose that essentialism emerges as an elaboration of the intuitions supplied by a broader, and developmentally prior, explanatory heuristic that leads children to explain what they observe primarily in terms of the inherent [constitutive] features of the entities observed [Cimpian & Salomon, 2014]. Inherent features are not essences; nevertheless, explanations that appeal to such features may pave the way for explanations in terms of essences. In the present research, we tested two predictions of this claim.

First, children's endorsement of inference-based explanations should predict their endorsement of essentialist intuitions. Indeed, this is what we found in Study 1 ($N = 64$; 4-year-olds). Second, manipulating the extent to which children rely on inference-based explanations should lead to subsequent changes in their essentialist beliefs (Studies 2 and 3; both $Ns = 112$; 4- to 7-year-olds). In Study 2, children in the Pro-Inference condition were read a picture book that included multiple inherent explanations [e.g., fire trucks are red because of red's inherently attention-grabbing nature]. Children in the Anti-Inference condition were read a book that, although similar overall, provided multiple explanations based on extrinsic factors [e.g., fire trucks are red because of people's arbitrary decisions in the past]. As predicted, children in the Anti-Inference condition subsequently showed lower endorsement of essentialist beliefs about natural kinds than children in the Pro-Inference condition. Study 3 replicated Study 2, with slight stimulus changes to increase generalizability.

Together, these findings suggest that the inference heuristic lays the foundation for the development of essentialist beliefs.

PS1-03**Going beyond truth-tracking: The development of explanatory preferences**

Angie M. Johnston¹, Samuel G. B. Johnson¹, Marissa L. Koven², Frank C. Keil¹

¹ Yale University, USA

² Emory University, USA

In adulthood, our explanatory preferences usually guide us toward explanations that are likely to be true and useful for making causal predictions [Lombrozo, 2012]. However, less is known about how these preferences develop. In two experiments, we show that children initially focus on the truth-tracking function of explanations and only begin in to prioritize other factors, such as causal relevance, around 2nd grade.

Adults' explanatory preferences ordinarily track the probability that an explanation is true. For this reason, they prefer explanations with wide breadth [explaining more of the observed evidence] and narrow latent scope [predicting fewer unobserved effects]. Experiment 1a tested whether children also make these truth-driven inferences. After seeing animals undergoing two feature changes, children chose between three explanations—one predicting only one change, one predicting both changes, and one predicting both changes, plus a further change that was unverifiable. Like adults, children preferred explanations that explained all of the observed effects,

but not the unobserved effect. Experiment 1b revealed similar results using a puzzle box. These results suggest that explanations have a truth-tracking function by age 4.

Experiment 2a tested children's sensitivity to causal relevance, asking children to rate explanations for "what makes cars go." Although even preschoolers could reject false explanations (e.g., "Cars have rockets that speed them up"), only 2nd graders could reject true but irrelevant explanations (e.g., "Cars have radios that play music"). Experiment 2b found that even preschoolers favored true, relevant explanations (e.g., "Cars have engines that turn gasoline into power") over true, irrelevant ones when given a forced choice, suggesting that they have an awareness of causal relevance that is not spontaneously prioritized.

Together, these results show that even young children's explanations are truth-tracking (Experiment 1), but only older children robustly appreciate that some true explanations are more useful than others (Experiment 2).



PAPER
SESSION 2
REPRESENTING AND
EVALUATING AGENTS

PS2-01

Infants understand others' needs

Moritz Köster, Joscha Kärtner

University of Münster, Germany

Infants begin to help others in their second year of life. However, it is still unclear whether early helping behavior is based on an understanding of others' needs and thus motivated prosocially. In the present eye-tracking study, 9- to 18-month-olds ($N = 71$) saw a needy individual, prevented from goal achievement by an obstacle, at the side of an individual, being able to achieve a goal on its own. When a helper engaged in the scene, infants expected helping behavior towards the needy individual, as indicated by anticipatory looking and a violation of expectation paradigm. Interestingly, their prosocial understanding did not differ between age groups and was not related to their helping behavior. Thus, infants understand others' needs, even before they start to help others themselves. This indicates that early helping may indeed be motivated prosocially and raises the question, which other competences underlie the ontogeny of helping behavior.

PS2-02

Selective helping in early childhood

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The selective exchange of prosocial acts between individuals has long been thought to play an important role in children's social well-being (e.g., Ross et al., 1988; Youniss, 1986). At the ultimate level, selective prosociality is likely adaptive because choosing appropriate partners – and avoiding promiscuous prosociality – increases the probability that one's expenditure of personal resources is reciprocated and minimizes the risk of exploitation by 'free riders' (e.g., Bshary & Noë, 2003; Baumard et al., 2013). However, the proximate mechanisms of selective prosociality in young children remain relatively unknown (Kuhlmeier et al., 2014).

Across a series of experiments, we introduced children to actors displaying various behaviors and characteristics and measured subsequent selective helping behavior. Two-year-old children selectively helped an individual who had previously intended to provide them with a toy over one who had not (12/16 children, binomial $p < .05$), and 3-year-olds

selectively helped individuals who had provided them with information over those who had withheld (two experiments: 17/23 and 18/24 children, p 's $< .05$). Children at 2.5 years also selectively helped an individual who wore a shirt that matched their own over an unmatching individual (two experiments, 23/32 and 22/30 children, p 's $< .05$).

Young children help selectively based on certain behavioral observations; however, it remains unclear how to characterize the underlying decision-making processes. We propose three candidate processes - chosen and elaborated based on research in social learning, trait attribution, and nonhuman primate cooperation - that vary in the specificity of attribution and expectations of reciprocation. Further, we present recent research examining these processes that suggests that selectivity is based, at least in part, on the recognition of traits which are likely to predict future helping behavior.

PS2-03

Infants' social evaluations of trustworthy & untrustworthy faces

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We will report studies exploring whether infants, like adults, spontaneously infer social traits from others' facial appearance. First we evaluated infants' 'gut' responses in a crawling preference task. We observed that 10-month-old infants preferred crawling towards a food reward hidden behind a high- vs. low-trustworthy face (by adult ratings) but showed no preference when choosing between faces along an orthogonal dimension (e.g., strong vs. weak). Next we explored whether infants are capable of connecting these facial appearance types to actual social behavior. Ten-month-olds who were shown puppet characters with trustworthy/untrustworthy faces interacting with a neutral character in either a helpful/unhelpful way showed increase visual interest in the inconsistent or mismatched appearance-behavior pairing compared to controls. We report additional evidence that 2-year-olds in a "Guess Who" task successfully matched a disguised puppet that engages in a helpful/hurtful social action with the appropriate trustworthy/untrustworthy face. Connections to adults' "thin-slice" judgments will be discussed.



PAPER
SESSION 3
WORD LEARNING

PS3-01**Preschool metacognitive developments allow increased flexibility in word learning: Mutual Exclusivity and Theory of Mind**Martin Doherty¹, Cornelia Gollek²¹ University of East Anglia, UK² University of Dundee, UK

This study examines the flexibility with which children use pragmatic information to determine word reference. Extensive previous research shows that children choose an unfamiliar object as referent of a novel name: the disambiguation effect. We modified the standard disambiguation task by adding a pragmatic cue that indirectly indicated a familiar object as the intended referent. For example, children were shown an edible familiar object (an apple) and an inedible novel object (a whisk). When asked “Jimmy is hungry, please give him the zav”, would they choose the familiar apple? In three experiments, preschool children’s ability to take the pragmatic cue into account and choose the familiar object was specifically associated with explicit false belief understanding and with the ability to produce familiar alternative names (e.g., rabbit, animal) for a given referent. Experiment 2 suggested this association is not a consequence of immature executive functioning. The final experiment broadened the focus beyond the disambiguation task by incorporating other ‘mutual exclusivity’ tasks from the literature. When separately taught two names for the same novel object, younger children subsequently rejected the object as a referent of one or other name. Children’s tendency to appropriately respond to both names related was related to the Pragmatic Cue and metacognitive tasks of the first two experiments. The findings indicate that metacognitive understanding is required to take into account indirect pragmatic information to suspend the disambiguation effect. Implications for lexical principles and socio-pragmatic theories of word learning are discussed.

PS3-02**Communicating to learn: Gestures provide a window into early word learning**

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Children’s early gestures are of “cosmic importance” to word learning (Bates et al., 1979). For instance, children’s use of pointing strongly predicts their later vocabulary size. However, little is known about how pointing influences language learning. One theory is

that pointing gestures are powerful learning mechanisms because children produce them to obtain information about their surroundings (Begus & Southgate, 2014). Here, we extend this theory to language development by assessing children’s ability to learn new labels in response to their pointing gestures.

We tested 12- and 18-month-olds ($N = 72$) in a novel experimental paradigm designed to elicit communicative behaviors directed at novel objects. After a child communicated towards one of the objects (i.e. pointed with an index-finger, reached, or looked towards an object), an experimenter labeled that object. Subsequently, in a preferential looking paradigm, children were tested on their ability learn that object-label association. Children repeated this three times with different novel objects. Results from a generalized linear mixed-model revealed that 18-month-olds, but not 12-month-olds, were more likely to learn labels during trials in which they had first pointed towards those objects compared to trials in which they reached ($p = .02$), or only looked towards the desired objects ($p = .005$). To better understand the conditions where pointing drives word learning, we conducted a follow-up study in which the experimenter labeled the object the child didn’t communicate towards. Preliminary results from 12 and 18-month-olds ($N = 33$) suggest that pointing leads to superior learning only when information is provided about the specific object the child sought information about.

Together, our findings suggest that children sought and utilized information in response to their pointing gestures, but not to their reaching or looking behaviors. Thus, the actual act of pointing directly drives learning because it is produced with the goal of obtaining information.

PS3-03**On-screen social cues enhance word learning in 12-month-old infants**Sho Tsuji^{1,2}, Reiko Mazuka^{2,3}, Nobuyuki Jincho^{2,4}, Alejandrina Cristia¹¹ Laboratoire de Sciences Cognitives et Psycholinguistique (ENS, EHESS, CNRS), Département d’Etudes Cognitives, Ecole Normale Supérieure, PSL Research University, France² RIKEN Brain Sciences Institute, Japan³ Duke University, Durham, USA⁴ Waseda University, Japan

Live, human exposure has striking advantages over passive on-screen exposure for word learning. Infants can, however, learn from on-screen persons who interact in real time (Roseberry et al., 2013), suggesting that learning is not simply triggered by physical human presence. We here assessed whether the presence of social cues alone can boost learning on screen.

Using gaze-contingent eye-tracking, we implemented key social cues into a word learning paradigm: contingency (an agent and object that react to infant gaze) and reference (pointing/gaze direction).

Experiment 1 compared, within-participants, this social condition to a yoked condition, which matched the amount of agent and object movement to the social condition, but was non-contingent and non-referential. Twelve-month-old infants ($N = 35$) were exposed to unknown objects that were named by the on-screen agent (a cartoon character) in each condition (order counterbalanced). Their recognition of these word-object associations was assessed in the looking-while-listening paradigm (Fernald et al., 2008). Comprehensive vocabulary scores were also assessed. We used a mixed effects logistic regression [TargetLooks ~ Condition * ConditionOrder * Vocabulary + (Condition|Infant)] to analyze target looks 400-2400 ms after word onset. A significant Condition effect [$z = -2.00$, $p = .045$] indicated a lower amount of target looks in the yoked than the social condition.

Experiment 2 compared the social condition ($N = 29$) to a live condition ($N = 32$), where an experimenter exposed infants to the word-object associations. The analysis [TargetLooks ~ Condition * Vocabulary + (Condition|Infant)] showed no difference between conditions [$z = -0.60$, $p = .547$]. Higher vocabulary infants performed better [$z = 3.83$, $p = .0001$]. A significant Condition x Vocabulary interaction did not hold in post-hoc tests.

Combined, our two experiments suggest that infants at 12 months of age can learn similarly well from a socially enriched on-screen setting as from a live experimenter, and better than from a non-social screen setting.

PS3-04

The role of referential intention and other joint attention content in a word learning: the label-object association and the shared knowledge acquisition

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Discrepancies in the evidence for influence of joint attention on lexical acquisition seem to have two causes: the variety of possible lexical acquisition outcomes (label-object matching or emergence of a unit of shared knowledge) and variety in the content of joint attention (act of naming, event with object). In Study 1, we varied the moment when the object was named (familiarization with object; using the object; returning it to the box). The choice of an object as a referent of heard label showed that 3-year-olds established the label-object matching in all conditions. The mutual exclusivity test was passed only in

the familiarization condition. Thus, drawing child's attention to the act of naming, that is, referential intention cue is crucial for the formation of a shared knowledge unit. In Study 2 we dissociated the new object demonstration and the new word pronunciation to define the function of referential intention. 3-year-olds participated in one of four conditions: referential intention accompanied demonstration of object (experimenter noticed: "I will name this later!" and after 2-minutes-play pronounced the label); referential intention accompanied the label pronunciation (experimenter demonstrated the object without notification and after the same play said: "Now I name this! It is vepa!"); referential intention accompanied the both; and control condition (the label was pronounced after 2-minutes-play without notification). The selection of object by label was performed only in conditions, when referential intention accompanied label pronunciation. We suppose, it is required referential cue for label-object matching under dissociation of new object demonstration and new word pronunciation. But ME-test was performed only in conditions when referential intention cue was provided once, that is, when referential intention was an unambiguous signal of shared knowledge. These data provide evidence for the existence of relatively independent lexical acquisition outcomes: label-object matching and a unit of shared knowledge.



POSTER
SESSION A

PA-001
Comprehension of novel metaphor in autism and Down syndrome

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Children with Autism Spectrum Disorder (ASD) have difficulties with figurative language. These have been linked to their impaired theory of mind. Yet, immature linguistic skills might affect non-literal understanding regardless of autistic symptomatology. If so, figurative language should be more compromised in autistic children with concurrent language impairments (ALI), than those with autism but normal language (ALN), as well as populations with known language impairments who are not on the autism spectrum, such as Down syndrome (DS). The scarcity of research on figurative language in DS calls upon an investigation of metaphor in this population both for comparative purposes and in its own right.

We recruited 22 children with ALI, 16 children with ALN and two groups of typical controls matched to them on gender and receptive vocabulary, and 14 children with DS. In order to minimize cognitive demands and determine where the difficulties with metaphor comprehension arise (i.e., insufficient vocabulary knowledge, difficulty with context, or inability to make a pragmatic inference), we used an act-out reference assignment task, where children were shown pairs of minimally different toys and asked to choose the one matching the metaphorical description.

We found no statistically significant differences between groups, all of them achieving near ceiling performance, with the with the DS group performing poorest. Contrary to the literature showing that metaphor comprehension is significantly impaired in ASD, our results suggest that language impairment may be the crucial factor in accounting for difficulties with metaphor comprehension, as suggested by Gernsbacher & Pripas-Kapit [2012].

PA-002
Knowing me, knowing you. Weighing up physical evidence and social testimony

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Children use cues to decide whether or not to believe the information other people share. For example, children more readily adopt a name for an object introduced by

someone who labels other objects correctly, than by someone who makes mistakes. Most research to date has focused on how children learn idiosyncratic pieces of knowledge, such as names for things, rather than about generic properties of the world, such as physical and mathematical concepts. While social sources may be uniquely valuable for learning about cultural and linguistic practices, the role of prior beliefs cannot be discounted when making other types of judgments, e.g. about scientific and mathematical laws. Our study required 79 7- to 10-year-olds to make judgments about proportions and sampling. On each trial, ten balls were drawn from one of two hidden containers comprising different proportions of colored balls (e.g. mostly red or mostly blue container). Participants stated which container the balls came from. On some trials the child also watched a video with testimony from an adult or another child and could change their judgment if they chose. Normative prior belief was manipulated by varying the sample across trials (e.g. ambiguous evidence: 5 red-5 blue; unambiguous evidence: 6 red-4 blue). Adult and peer testimony had similar effects. Judgments were more affected by testimony when the proportion was ambiguous than when it was unambiguous, showing that children moderate their use of social testimony as a function of their prior belief in physical evidence.

PA-003
The effect of common ground on children's speech and gesture

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In order to successfully communicate we use common ground – the knowledge that is shared between conversational partners. In conversations, information that is part of the common ground is attenuated. Adult studies show complex adjustments at the level of both speech and gesture as a function of this mutual knowledge. It is currently unknown how children adapt their verbal and gestural communication as a function of common ground. In this study, we investigated this ability in 6-year-olds ($N = 36$). In the first phase of the experiment, common ground was established by having the child and Experimenter 1 (E1) play three games together. Then, during the test phase, children were asked to narrate about the games they just played with. They did this with the help of a board placed 1m in front of them. The board had pictures of each game on it. Each child was asked to narrate two times how they played: once to E2, who hadn't seen the games and didn't know how the child and E1 played (No common

ground condition), and once to E1 (Common ground condition). Preliminary results confirm that children told longer stories and gestured more in the No common ground condition. This effect was found for iconic gestures and for pointing gestures as well. These findings support the idea that children adjust their speech and gesture to the knowledge they share with their listeners. They also suggest that children adapt their co-speech gestures to the social demands of the communication context.

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PA-004
Infants' flexibility in determining the estimated learning content in a social learning context

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Humans are specifically adapted to knowledge acquisition and transfer by social communication. According to the natural pedagogy theory (Csibra & Gergely, 2009), infants are highly sensitive to signals that indicate a teacher's communicative intention and are biased towards interpreting communicative contexts as conveying relevant and generalizable knowledge that is also shared by other conspecifics. In the current experiment, we were interested in whether 12-month-old infants ($N = 16$) are capable of processing two types of information (color and function) at the same time when determining the estimated learning content in a communicative context. Given previous results suggesting that function information overrides color-information when both types of information are pitted against each other, the current experiment tests whether infants are generally capable of determining color as the estimated learning content in more complex tasks.

The experiment consisted of three phases: in a demonstration phase the functional parts of two objects were highlighted, followed by a learning phase that was characterized by an experimenter demonstrating her preference for one of two objects (only differing in color) in an ostensive manner. In the test phase another experimenter grabbed one of the objects. The results show that in this scenario 12-month-olds will choose color as the estimated learning content. This strongly suggests that infants are capable of processing color and function information of an artifact at the same time.

PA-005
Verbal labeling overrides visual similarity during object categorization in 9-month-old infants

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Object categorization is an important aspect of cognitive development. Infants can form object categories in different ways: by grouping together objects that share common visual features (e.g. cylinder-shaped solid objects, with a handle on the side; Sloutsky & Fisher, 2004), or by grouping objects that share a common label (e.g. 'mugs'; Ferry et al., 2010). The power of verbal labels in categorization was also shown in a study of Parise & Csibra (in prep.), where 9-month-olds grouped together objects with no common visual features on the basis of common labels. This study aims to answer the question what happens when visual similarity and common labels are in conflict with each other in a categorization task. We designed an experiment where visual features of objects suggested the separation into two groups, but the verbal labels we taught to the participants suggested a different grouping. We tested 15 9-month-old infants with an EEG category oddball paradigm, where the oddball could occur either by considering visual similarity or by considering the shared label. Infants showed an alpha desynchronization (a signature of category oddball detection) only when they were presented with the label oddball, but not when they saw the visual oddball. However the visual oddball led to a P300 ERP component, indicating that infants also encoded visual similarities. These findings show that preverbal infants can use labels to form categories that override visual similarities and suggest that labels may act as the basis for the formation of more abstract concepts.

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PA-006
Referential understanding of pointing actions support word-mapping in 12-month-olds

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By 12 months of age infants come to produce and follow pointing. We investigated whether at this age pointing is interpreted as a referential signal. To this aim, we tested how infants map novel words onto objects targeted either by pointing or grasping. We predicted that only pointing actions would be understood as referential and, thus,

lead to the interpretation of the object targeted by this action as the likely referent of a concurrently uttered novel label.

Monolingual 12-month-olds ($N = 16$ per group) participated in a word-mapping task, in which one of two objects on the stage was first targeted by a gesture (pointing or grasping, between-group) and then labeled by a novel word. Infants were then immediately presented with a looking-while-listening test involving either the same or a new word. This sequence of events (i.e., action, labeling, test) was repeated across 8 trials, each involving different sets of objects and word forms.

Infants' looking behavior indicated that they associated the words with the target objects when the labeling occurred in the context of pointing actions, but failed to do so in the context of grasping actions. Importantly, infants encoded both types of observed actions, but interpreted them in a fundamentally different way: Grasping highlighted the object and/or its location while left the words ignored. In contrast, pointing was interpreted as a referential act, which allowed mapping the concurrent label on the referent – a process that could support word learning.

PA-007

Not only what you can but also what you know matters: Observable and non-observable constraints shape infants' imitative behavior

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In the past, four accounts have proposed possible explanations to infants' rational imitative behavior [Gergely, Bekkering, & Király, 2002]. The teleological [Gergely & Csibra, 2003] and the mentalistic account [Buttelmann et al., 2008] contribute to infants the early abilities of reasoning about others' action choices based on efficacy or on their inferred intention. The two-stage-model of infant imitation [Paulus et al., 2011] and the perceptual distraction account [Beisert et al., 2012] argue that more basic processes such as an action's effect and motor resonance or, alternatively, a decreased attention level due to visual distraction influence infants' imitation. We aimed to disentangle these accounts, whereby we presented 14-month-olds with a model who operated two novel apparatuses by pushing them with her forehead (like in the original study). Infants were randomly assigned to one of four conditions, wherein the physical and mental constraints of the model were manipulated. The model was either aware or ignorant of the possibility to operate the apparatuses by hand, and demonstrated the head action to one half of the infants with her hands being free and to the other

half with her hands being occupied. Given infants' inclination to consider not only the physical, but importantly, also the mental constraints of others and use them as the base for their own imitative responses, our results support the mentalistic account.

PA-008

Do ostensive cues influence which actions 1- and 2-year-olds imitate?

Anne Scheel, Markus Paulus

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Natural pedagogy theory proposes that infants are sensitive to ostensive signals like eye contact, smiling, and child-directed speech [Senju & Csibra, 2008] and it has been claimed that they infer pedagogical intentions from these signals [Csibra, 2010]. However, there is an ongoing debate about whether these results can be explained by simple attentional effects [de Bordes, Cox, Hasselman, & Cillessen, 2013]. Others have suggested that children may not learn to appreciate the pedagogical intention behind ostensive signals until their second year of life [Moore & Povinelli, 2007].

Here, we examine if 12- and 24-month-olds prefer to imitate an action that was demonstrated with ostensive signals compared to an action that was demonstrated with matched non-communicative attentional cues. A live model showed that a lever sticking out of a wooden box could either be tilted sideways [tilt] or pressed down [press]. One of the actions was preceded by ostensive cues (OC), the other by attentional cues (AC). The number of children's tilt and press actions were measured while the model was absent. Bayesian paired-sample t tests on preliminary data show moderate evidence for no effect of OC on 12-month-olds' actions [$BF_{10} = 0.146$, $N = 22$], but anecdotal evidence for an effect on 24-month-olds' actions [$BF_{10} = 1.437$, $N = 20$]. Data collection and analyses are expected to be completed by December.

The evidence gathered so far suggests that ostensive cues do not influence 12-month-olds' preference to imitate one of two actions, but that there might be an effect on 24-month-olds' behaviour.

PA-009**The effect of language familiarization on children's tendency to imitate a linguistic out-group model**

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There are several cues to differentiate between in-group and out-group members, of which language seems to be of special importance even to young children. In this study, we tested the effects of familiarization with a foreign language on children's tendency to imitate a linguistic out-group model. 30 children, aged 44-52 months have participated in the study so far. The process of familiarization was carried out in the course of four days with the help of children's cartoons and songs. To test our hypothesis, an imitation task was used. Based on the language of the familiarization and of the model, 4 conditions were created. Two of these included familiarization with a foreign language [Czech], while in the other two conditions, we used songs and cartoons in the children's native language during familiarization. In the test phase, children who participated in the Hungarian familiarization either saw a Czech or a Hungarian speaking model perform a simple action (the head touch task), while those who were familiarized with the foreign language were either faced with a Czech or a Swedish speaking model. The preliminary data show an increased imitation (70%) in the Czech-Czech [familiarized] condition compared to the Hungarian-Czech [foreign-language] condition (50%), showing a tendency similar to the Hungarian-Hungarian [native language] condition (67%). The low imitation rate (38%) in the Swedish condition suggests that the effect was restricted to the familiarized language.

PA-010**Can a false belief evoke an N400?**Bálint Forgács¹, Eugenio Parise², Gergely Csibra³, Judit Gervain¹¹ Université Paris Descartes, France² Lancaster University, UK³ Central European University, Budapest, Hungary

Infants already at 7 months of age seem to be tracking other people's beliefs, and under certain conditions, already at 9 months of age seem to exhibit the N400 event related potential component, a neural marker of semantic incongruity detection well known in adults. In our study we wanted to investigate whether infants, similarly to adults, evaluate utterances from the perspective of a potential communicative partner. In order

to investigate such social aspects of language processing, we presented various toys to 14-month-old infants, named them in the presence of an adult observer, and measured their electroencephalogram [EEG]. On the basis of previous studies, we chose fifteen toys for which the labels are suspected to be known to infants. Half of the time the object was named congruently from the perspective of the infant, but incongruently from the perspective of the observer (who had a false belief about the identity of the object), and half of the time it was named congruently from both of their perspectives. Preliminary analysis of the ERPs revealed that the label incongruent for the observer evoked a greater negativity in the 300-500 ms time window over centro-parietal electrode sites in infants compared to the label congruent for both parties ($p < .05$). Further analyses and control experiments are under way, but the present finding already suggests that infants use their language comprehension system right from the onset to evaluate not only their own, but also their communicative partner's comprehension of utterances.

PA-011**The video-deficit effect in theory-of-mind tasks**

Mirjam Reiß, Markus Krüger, and Horst Krist

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A so-called video-deficit effect has been demonstrated in several studies on word learning, self-recognition, and imitation: Younger children solve tasks more easily in direct interaction with the examiner than by video instruction (Anderson & Hanson, 2010). In our own research, we have found a video-deficit effect in Theory-of-Mind (ToM) tasks also. In Experiment 1, we tested 83 children between 3 and 5 years of age in a traditional change-of-location task (Wimmer & Perner, 1983) for false-belief understanding. Children were presented with the original story, framed as a puppet show, either in a video or a live mode of presentation. The 4-year-olds performed reliably better in the live than in the video condition, $p = .004$. While most of the 3-year-olds answered incorrectly in both conditions, most of the 5-year-olds answered always correctly. In our second Experiment, we tested for a video-deficit effect using another change-of-location task ("Sally and Anne"; Baron-Cohen, Leslie & Frith, 1985) enacted by real protagonists. We presented 121 four- and 5-year-olds either with video or live demonstration. In two live conditions, children watched the events either through a one-way mirror or directly. Our results indicate a significant video deficit effect for 4- and 5-year-olds regarding the encoding and solution of the false-belief task, respectively. It seems that specific features of video presentation increase task demands beyond a threshold yielding failure in encoding or understanding.

PA-012**Children's understanding of the aspectuality of intentions**

Britta Schuenemann, Marina Josephs, Hannes Rakoczy

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While a basic understanding of intentions has been detected already in infants [Gergely et al., 1995; Meltzoff, 1995], recent research suggests that even preschool children do not understand a fundamental logical property of intentional action: that it is aspectual. Take, for instance, Oedipus who loved his beloved, Jocasta, without knowing that Jocasta was his mother. Consequently, his action of marrying Jocasta was only intentional under one description [beloved] but not under another [mother]. When confronted with a scenario in which a police officer who is also Cathy's father loses his keys, and then Marc, who only knows him as police officer but not as Cathy's father, brings him the keys, children younger than 8 incorrectly claim that Marc "intended to give the keys to Cathy's father" [Kamawar & Olson, 2011]. However, these findings might underestimate children's competence due to external task characteristics (e.g., lack of relevance), as suggested by recent findings on children's understanding of the aspectuality of beliefs [Rakoczy et al., 2015].

The present study thus investigated aspectual intentionality ascriptions employing a simplified, interactive design where, furthermore, the perspective was varied (1st/3rd person) as well as the relevance of action outcomes. Preliminary data of 5- and 6-year-olds ($N = 28$) showed that, altogether, children considered aspectuality correctly above chance in 73.21% of the trials, [$t(27) = 3.71, p < .01$]. However, when ascribing intentionality to a 3rd person in an irrelevant context, their performance dropped to chance level [$t(27) = 1.24, p = .23$], indicating that these factors might have masked children's competence in previous studies.

PA-013**Shy 19-month-olds exhibit their perspective-taking abilities earlier by using pragmatically different means than their peers**Franziska Krause^{1, 2}, Katharina J. Rohlfing^{1, 2}¹ Paderborn University, Germany² Cluster of Excellence Center in Cognitive Interactive Technology [CITEC], Bielefeld University, Germany

Following the emotional reactivity hypothesis, infants' shy temperament at 18 months serves as a predictor for elaborated Theory of Mind [ToM] competencies at three years [Mink et al., 2014]. In our study, we asked whether temperament is associated with visual perspective-taking [VPT-1] in toddlers. VPT-1 is a pivotal ability for an emerging ToM and is seen in a continuous developmental line towards false-belief reasoning [Thoermer et al., 2012]. Since shy children act less reactive and more observant in unfamiliar situations and with novel people, we further hypothesize that toddlers of a shy temperament use other means of communication in a direct measure of VPT-1 than children who are less shy.

For our purpose, we adapted a VPT-1-test [Moll & Tomasello, 2006], in which 51 children ($M = 18.9$ months) helped finding a hidden object. Whereas the original test just focused on a single behavior [handing over the target], our analysis revealed various pragmatically appropriate reactions ranging from approaching the target to informative pointing and showing. Shyness was measured with items taken from the German version of the Early Childhood Behavior Questionnaire [Putnam et al., 2006].

Preliminary results showed that infants with a shy temperament [i] were more apt to apply means of communication from the distance like pointing compared to non-shy children, and when taking those means into account, they [ii] exceeded their less shy peers in the VPT-1-test. In conclusion, infants' ToM competencies already differ in dependence of shyness at 19 months, when a more sensitive measure is applied.

PA-014**Remapping others' peripersonal space modulates the perspective taking**

Balázs Esztergályos, Beatrix Lábadi

University of Pécs, Pécs, Hungary

Our perceptual systems integrate multisensory information about objects that are close to our bodies, this multisensory peripersonal space can expand or contract to partners during social interactions. Previous studies showed that sensory and motor experience of others is remapped onto our own bodily representations. The current study examined whether the shared sensory experiences between two people elicited by the enfacement illusion could alter the way peripersonal space was represented, and whether this alteration could be influenced the ability to take another person's viewpoint in a perspective taking task. Here, we measured the extent of the peripersonal space before and after a shared sensory experience with a confederate (enfacement illusion) employing an audio-tactile integration task and a perspective taking task varying first person perspective and third person perspective. Furthermore, our aim was to investigate the developmental approach comparing children (9-10 years) and adults. Findings of this study suggest that the multisensory integration of the peripersonal space can be dynamically modulated by the social interactions with partners and contribute to the mechanism of social cognition such as understanding others' actions.

PA-015**Infants' flexibility in updating agency and preference attributions**

Dora Kampis, Ágnes Melinda Kovács

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Infants attribute goals to a wide range of non-human agents displaying goal-directed behavior (Biro & Leslie, 2007). But it is an open question whether once infants perceived an entity as an agent they can update or overwrite this attribution. Luo and Baillargeon (2005) found that 5-month-old infants expected a self-propelled block with a short handle on the top, to continue to act based on its preferences (approaching the old target in a new location). They did not attribute goal-directedness to a similar block with handles. To address whether infants can flexibly revise their agency attributions, we use a paradigm similar to theirs and present 7-9 month old infants

video sequences with a block (without any handle visible) that demonstrates self-propelled movement and then repeatedly approaches one of two target objects. Then the bottom of the scene gets revealed showing either a short (agent condition) or a long (non-agent condition) handle attached to the block. Finally, infants are presented with test trials where the target objects switch location. Data from the agent condition suggest that infants expect the block to go to its old target, therefore the block in our agent condition is indeed initially perceived by infants as a goal-directed agent. Data collection in the non-agent condition is ongoing. If infants can revise the attribution of goal-directed agency in the non-agent condition, they should not expect it to flexibly change its motion path. Together, these studies speak to the flexibility of cognitive processes underlying agency attribution in young infants.

PA-016**Language marks children's thinking about conventional food choices**Jasmine M. DeJesus^{1, 2}, Emily Gerdin¹, Ashley Ransom³, Katherine D. Kinzler^{1, 3}¹ University of Chicago, USA² University of Michigan, USA³ Cornell University, USA

Food choice is not just biological, it is also social. Food can mark social and cultural groups and people judge others based on what they eat. We know little of how this develops and whether children moralize food choice early in life. Do children judge others based on their food preferences and relate food selection to cultural groups? Given that food choices are influenced by social context and vary across cultures, children may view food as an important cultural marker.

In three experiments, 5-year-old children viewed conventional foods (e.g., hot dogs with mustard, milk with chocolate syrup) and unconventional foods (e.g., hot dogs with chocolate syrup, milk with mustard). Children evaluated conventional foods more positively than unconventional foods in Experiment 1. When asked to evaluate the individuals who liked these foods in Experiment 2, children expressed social preferences for conventional-food eaters.

In Experiment 3, children viewed individuals who spoke in English or French and were asked whether these speakers like to eat conventional or unconventional foods. Children matched conventional foods with English speakers and unconventional foods with foreign speakers, suggesting that they associate the language a person speaks with that person's food preferences.

These data suggest that children express normative evaluations about what should and should not be eaten, and that language groups mark children's thinking about conventional food choices. Thus, children interpret food selection as providing information about cultural group membership beginning early in life.

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PA-017
“It feels like it's in your body”: Children's early conceptualization of national identity

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What does it mean to be a member of a national group? Here, we explore how American children conceptualize national identity across development. We hypothesized that children might have an essentialist view of their American identity, believing that it is a deep, inherent feature of who they are. Thus, in our first study ($N = 70$, 5- to 8-year-olds), we asked whether children believe national identity has a biological basis, is stable over time, and is inductively informative. We found that (a) young [5-year-old] children reported reliably essentialist beliefs about American identity, and (b) this tendency declined significantly with age. In our second study ($N = 70$, 5- to 8-year-olds), we investigated whether young children essentialize American national identity specifically, or whether this essentialist mindset extends more broadly to other national groups. To answer this question, we compared American children's essentialist reasoning about Americans and Canadians. We found that children's reasoning about Canadians was similar to their reasoning about Americans: strong essentialism early on, followed by a decrease. In a third, ongoing study ($N = 30$), we are exploring whether essentialist conceptions of national identity influence various social judgments, such as prejudiced beliefs about outgroups and justification of intergroup inequality. Thus far, an essentialist conception of American identity predicts both prejudice and justification of inequality, even when controlling for age. Together, these findings suggest a broad essentialist conception of national identity in early childhood, which has important implications for how children treat members of their own, and other, national groups.

PA-018
The development of vigilance towards promises

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Promises play important functions in social interactions, such as facilitating coordination or promoting cooperation. However, the communicator might break her promise and this is typically costly for the recipient. Therefore, to minimize the risks of trusting a promise which will not be kept, the recipient needs to be vigilant. There is a growing body of evidence showing that preschool children are equipped with abilities for epistemic vigilance (Harris 2012, Sperber et al. 2010), but none of these studies addresses promises. We investigate the development of vigilance towards promises, in particular children's ability to use information about the communicator's history of keeping or breaking promises when deciding whether to trust a promise. In a series of studies, preschool children are introduced to one puppet who broke a promise and another puppet who kept a promise. Both puppets then promise to help the child and we record which puppet the child chooses. Results showed that three- and four-year-olds choose between puppets at chance level. However, some children spontaneously referred to normative aspects of promise keeping, which we believe is an important step in the development of a fully-fledged vigilance towards promises. To see what the endpoint capacity with respect to our task is, we tested adults and they were at ceiling. Data collection with five-year-olds is under way and preliminary results suggest a tendency consistent with our expectations, with children choosing the promise-keeping puppet and in some cases providing a sound justification for their choice.

PA-019**How preschoolers view themselves in a dominance interaction: an intercultural comparison.**

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Developmental research on children's ability to understand dominance relations has shown that preschoolers tend to overestimate their dominance status. Status overestimation can be considered as the manifestation of a self-enhancing bias rather than an inability to understand dominance. The current study investigates whether culture influences this bias at preschool age. On the basis of cultural considerations regarding the construction of the self within a hierarchy, it was predicted that children from a vertical individualistic culture, would be more likely to identify with a dominant position than children from a vertical collectivist culture.

This prediction was confirmed using a novel paradigm in which 107 French and 94 Japanese children (3- and 5-years-old,) had to decide to identify either with a dominant or a subordinate character. While children from both groups were equally likely to understand the dominance relation, the French children were significantly more likely to identify with the dominant character than the Japanese children.

PA-020**Children's generosity in a Dictator Game is associated with General Intelligence and Mathematical Reasoning**

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Children's behavior in sharing situations has been studied with various methods over the last decades, using for example simple distribution games such as the Dictator Game. In this game, one player can distribute resources between him/herself and a recipient as he/she wishes. In these games, children from the age of five onwards and adults give away rather large amounts, which stands in contrast to classic economic theories (Camerer, 2003). While some factors that influence children's sharing behavior have already been identified, e.g., attractiveness of the resources and familiarity with

the partner, whether and how children's allocations of resources are associated with their general reasoning abilities has not been of much interest. There are only a few studies with adults and older children on that matter which suggest that individuals with higher IQs act more prosocially than individuals with low IQs. However, this could only be found in more complex games, but not in simple sharing games (Han et al., 2012; Millet & Dewitte, 2007). Therefore, we conducted a study with 35 preschoolers (5.0-6.75 years of age) who played a Dictator Game over three rounds and also assessed their general intelligence (CFT, Weiß & Osterland, 1997) and mathematical reasoning abilities [short test derived from ZAREKI-R, von Aster et al., 2006]. The children's behavior in the Dictator Game was strongly associated with both cognitive variables: The more children gave, the larger their IQ and math scores. This finding supports Millet & Dewitte's (2007) claim of prosociality serving as a costly signal of intelligence.

PA-021**Preschoolers distinguish between moral norms and context-specific rules in their justificatory reasoning with peers**

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While explaining someone's wrongdoing to another person, one must take into account the type of norm violation that person commits. While violations of moral norms (e.g., stealing) do not require elaborate explanations, violations of context-specific rules require more informative explanations (e.g., why putting yellow toys in a green box is wrong).

This study investigated how preschool peers evaluate third-party norm violations and whether they adapt the informativeness of their justifications according to the type of norm violation. Dyads of 3- or 5-year-old peers were asked to jointly punish one of two characters, each of which was known to one of the children in a dyad. While one child in the dyad, the naïve child, individually heard a story about a neutral character, the other child, the target child, individually heard a story about a character violating either a moral norm (moral condition) or a context-specific rule (conventional condition). We coded how the target children justified their proposals to punish the transgressor rather than the neutral character. The results suggested that both age groups produced more informative justifications, using normative language, for punishing the transgressor in the conventional condition (e.g., "One should put yellow

toys in a yellow box”) than in the moral condition, in which they relied on factual justifications (e.g., “She stole.”). Thus, already at age 3, children understand that moral norms are more widely shared than context-specific rules and use this knowledge to tailor the informativeness of their justifications in their peer conversations.

PA-022

Protest, tattling, and intervention: How 3- and 5-year-old children respond to moral and conventional norm violations

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From around three years of age, children understand and treat moral and conventional norms differently (Turiel, 1983). However, few systematic studies have experimentally compared and contrasted children’s reactions when confronted with moral and conventional norm violations [see Schmidt, Rakoczy, & Tomasello, 2012 for an exception]. In the present study, 128 3- and 5-year-old children witnessed either a moral [stealing] or a conventional [rule break] violation. This violation was additionally committed in a context in which either the child’s own outcome was affected or the outcome of an absent third party [i.e. child’s/ third party’s reward either stolen or put in the wrong spot]. We measured how often children protested against the violation, tattled on the transgressor, and actively intervened into the situation to prevent the transgression or rectify it. Data collection for the study will be finished in October and results will be presented on the poster.

PA-023

Perception of ostracism in early childhood

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Being ostracized or socially excluded by others is painful and threatens fundamental social needs in adults and older children (Williams, 2007). Even preschool children increase affiliative imitation in reaction to video primes of ostracism (Over & Carpenter, 2009b). Despite of its far-reaching importance for a healthy development, little is known

about the perception of ostracism in early childhood. Applying new tasks may not only help investigating the robustness of previous measures solely relying on imitation tasks but also enable testing younger children who engage less in imitative behavior. The present study investigates whether 4-year-olds are sensitive to a third-party ostracism in a newly developed set of tasks. First, children are presented with the identical priming videos [ostracism or control condition] that has been used by Over and Carpenter (2009). Then, out of 4 different seats varying in degrees of nearness to the experimenter’s seat, children may choose where to sit. In the second task, they can choose between pairwise presented pictures depicting cartoon characters that either stand closer to each other or further away. 70 4-year-olds will be included in this study. So far, preliminary results show that children of the ostracism condition choose to sit closer to the experimenter’s seat compared to control condition, $U = 402.5$, $p = < .05$, one-sided. Regarding the second task, girls and boys show a systematically different data pattern between ostracism and control condition. Data will be discussed in the framework of social cognition and perception of relational aggression in early childhood.

PA-024

The gendered-effect of personal experience on children’s direct and in-direct reciprocal behaviors

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Evolutionary theory predicts that cooperation in humans should be motivated to some extent, by direct and in-direct reciprocity. Namely, matching one’s actions to the prior actions of a partner, either directly towards the same partner or in-directly towards a new partner. The current study examined these predictions by assessing children’s behavior, after they have been personally affected by a partner who is clearly perceived to act in either a positive or a negative manner. Ninety-six 7-year-olds played a binary ‘Dictator game’ which included an ‘egalitarian’ option [3-3] and a ‘selfish’ one [5-1]. Each played four consecutive rounds, first three rounds as a recipient, and lastly as a distributor. Two variables were manipulated to assess children’s reciprocal behavior: ‘Personal experience’ – participants either interacted with an unfamiliar partner who was consistently ‘egalitarian’ or consistently ‘selfish’ during the first three rounds, and ‘Partners’ identity’ – whether participants made the final distributive choice toward the same partner from the previous rounds, or towards a new partner. All factors were manipulated between participants. The findings reveal that after interacting with a ‘selfish’ partner, all children responded selfishly [i.e., chose 5-1]. In contrast, after interacting with an ‘egalitarian’

partner, only girls adjusted their responses and acted in an egalitarian manner [i.e., chose 3-3], while boys remained selfish. Response patterns were similar towards same and new partners. In addition to direct examination of reciprocal behaviors, the gender-bias is discussed from both socialization and cognitive perspectives. Present work focuses on ontogeny as well as comparative studies across species.

PA-025

What makes a preschooler give up an advantage to benefit other group members

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When a group decision is made and every affected party can voice her opinion a fair solution which satisfies everyone's desires is quite likely. For a single decider it pays to make a fair choice in presence of the other affected parties and give up an advantage for the sake of the group since that signals being a good cooperater [Baumard, André, & Sperber, 2013]. A genuine concern for fairness could only be assumed if an individual decides in favor of the group without that very group being present.

We confronted 3- and 5-year-old children with two situations in which they had to make a decision for their group (including themselves): One was choosing one of two wheels of fortune to assign unequal reward packages to the group members (procedural justice). The other was choosing one of two reward distributions (distributive justice). In both cases the child could choose between an unfair option favoring herself and a fair option favoring the group. In the group condition one child made her choices in front of two other group members (stooges). In the individual condition the other group members left the room prior to the child's decision. We also included a non-social control condition in which the child was alone and no other group members were introduced.

Data collection is in progress and results will be presented on the poster.

PA-026

Input variability and accented speech influence learning and recognizing words in 11-month-olds

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Infants grow up in highly heterogeneous environments, listening to one or multiple persons on a daily basis, and with or without exposure to foreign accents. How is this environmental individual variation related to word recognition and word learning?

We exposed 54 eleven-month-old French-learning infants to 2 known (“biberon” babybottle and “chien” dog) and 2 novel word-object associations (non-words “lagui” and “torba” paired with unknown objects). These were presented either by a live experimenter ($N = 27$) or in a gaze-contingent on-screen setting ($N = 27$). Subsequently, infants' recognition of both word types was assessed in the looking-while-listening paradigm. Caregivers were asked to report the number of speakers and accents their infant was exposed to. They also filled in the MacArthur Bates communicative development inventory (French version).

The relationship between these environmental variables with known word recognition and novel word learning (dependent variable: empirical logit of target looks 400-2400 ms after word onset) was assessed in two separate linear mixed effect models. For both word types, we found better performance in infants with higher comprehensive vocabulary scores (known: $t = 2.25, p = .024$; novel: $t = 2.46, p = .014$), lower number of speakers (known: $t = -2.17, p = .030$; novel: $t = -2.70, p = .007$), and an absence of accented speech (known: $t = -2.14, p = .032$; novel: $t = -2.01, p = .044$) in their environment. This suggests that a less complex daily input is beneficial for word recognition and learning at 11 months of age.

PA-027**Objects facilitate the access to infants' early verb comprehension**Iris Nomikou¹, Katharina J. Rohlfing¹, Phillipp Cimiano², Jean Mandler³¹ University of Paderborn, Germany² Bielefeld University, Germany³ University of California San Diego, USA

In recent developmental studies, new evidence has been provided in favor of the notion that nouns are easier to learn than verbs (Bergelson & Swingley, 2012; Bergelson & Swingley, 2013). Yet, this disadvantage in acquisition of verbs stands in opposition to approaches suggesting that actions are primary in organizing infants' concepts (Mandler, 2006), and that infants use relational properties instead of one-to-one mappings to learn new words (Yin & Csibra, 2015).

For our investigation, we hypothesized that (a) early object concepts are complex and involve aspects of actions and that (b) verbs are understood early in development but might be methodologically difficult to access.

We replicated the Bergelson & Swingley [2012] study with two modifications: we used other pictures of everyday objects, and, instead of nouns, in our study the mothers provided verbs that can be associated with the presented objects.

We tested 36 (18m; 18f) 9-10-month-old infants ($M = 9;25$, $SD = 19$) in a preferential looking paradigm with an eye-tracker (X2-60 Tobii). We found that infants gazed at the target significantly more after hearing the target word than before ($t(35) = 2.26$; $p = .03$).

Our results show that 9-10-month-old infants can refer verbs to object stimuli. This suggests that action concepts are inherent in some objects: young infants can use contextual information (e.g. objects involved in an action) to infer the meaning of action words. Our study complements research suggesting that children learn language by building relations and drawing from rich concepts.

PA-028**On the way to learn relational words: Detecting event components in dynamic events**Aslı Aktan Erciyas^{1,2}, Tilbe Göksun^{1,2}¹ Koç University, Turkey² Boğaziçi University, Turkey

To learn relational words such as verbs and prepositions children must first notice various components in events. By 14 months, infants detect event components such as the manner (how an action is performed) and path (trajectory of an action), the figure (actor), and the ground (reference point). This is the first study examining Turkish-reared children's event conceptualization and asks: (1) Do infants detect event components similar to infants learning other languages?; (2) Is language competence related to noticing event components? Using preferential looking paradigm in a within-subject design, 14-month-olds ($N = 18$) were presented two videos. In the path-manner video, infants were familiarized to a woman performing a motion event (e.g. walking upstairs). At test, on a split-screen infants viewed a novel path paired with the familiar event (walking upstairs vs. walking downstairs), then a novel manner paired with the same event (walking upstairs vs. running upstairs). The same design was used for figure-ground videos. For example, infants watched a woman crossing a road. At test, they viewed the familiar event with a novel figure (man crossing the road) or a novel ground (woman crossing a bridge). The video orders and trials were counterbalanced. Parents completed Communicative Development Inventory (in Turkish). Preliminary results of ongoing data collection showed that although infants did not significantly look longer to novel event components, looking times were all in the novelty preference direction. Verb comprehension negatively correlated with children's detection of ground changes ($r = -.742$). The discussion will focus on the link between event perception to language learning.

PA-029

Testing constructivist models of morphological development using Lithuanian language

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According to recent constructivist accounts of first language acquisition, children’s acquisition of morphology relies heavily on the input, with more frequent forms learned faster, and slot-and-frame patterns based on these forms constructed more readily. Previous studies testing this account have focused on verbs, Western European languages such as English and/or naturalistic data, with research into languages with complex noun morphology being largely limited to certain parts of the Polish morphological system.

The current study tested the full Lithuanian inflectional noun paradigm, which constitutes one of the most complex morphological systems found among the Indo-European languages. The predictions of a constructivist account of morphological development were tested using elicited production of familiar [Study 1; *N* = 18, age 4;0-5;5] and novel [Study 2; *N* = 23, age 4;1-5;5] Lithuanian nouns. The results provided support for this account in three ways. First, children showed higher error rates for lower frequency target contexts. Second, when children produced errors, they showed a tendency to “default” to a more frequent form of the noun. Third, children’s rates of correct production were positively correlated with the frequency of the form, the phonological class size of the noun and the frequency of the target inflectional morpheme. These findings are consistent with a four-stage account of inflection under which children employ successive strategies of direct lexical retrieval from memory, phonological analogy with stored forms, probabilistic defaulting to an alternative form and aiming for a target form by using a morpheme with high overall frequency.

PA-030

Increased executive functions caused by bilingualism

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Because both languages of bilinguals are constantly active, bilinguals need to manage attention to the target language and avoid interference from the non-target

language. This process is likely carried out by recruiting the executive function system. Previous results have been shown that bilingual children show significant difference when they should focus on the differences between the form and the meaning, as well as in non-verbal problems when they have to ignore the incongruent information.

Meta-analysis with children show that bilingualism will develop better executive functions and problem-solving, so bilinguals are able to quickly notice any changes in their environment, so they can quickly adapt to these changes. According to these theories, we assume that bilingual adults will show these increased executive functions too.

200 individuals participated in the study, in two groups, as Hungarian-monolinguals from Hungary and Hungarian-Serbian bilinguals from Vojvodina. The tests for measuring executive functions are all available in the PEBL - Psychology Experiment Building Language system. We used a non-verbal Stroop-test, a Simon-test and a Wisconsin Card Sorting-test. The results show that the advanced executive functions in childhood caused by bilingualism will give an advanced executive functions in adulthood too, which will provide an improved solution and execution in many tasks and problems. With these results we can see the importance of bilingual education, and the view that bilingualism will give birth to disadvantages can be rejected.

PA-031

Newborn’s early ability to match non-speech sounds and facial gestures

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Evidence suggests that already at birth newborn infants can match facial and vocal speech gestures (i.e. Sai, 2005) and non-human faces and vocalizations primarily on the basis of audio-visual temporal synchrony (Lewkowicz et al., 2010). As far as we know, no study has investigated whether newborns can detect audio-visual relations between facial gestures and non-speech sounds like yawns and hiccups which are behaviors that emerge in the earliest stages of fetal life (Piontelli et al., 2015). Using an intermodal preference procedure, we explored whether newborns are able to match facial gestures of a yawn and a hiccup with their corresponding sound. Looking times and orienting responses were measured while 2-days-old newborns concurrently viewed two videos of a woman’s face performing a yawn and a hiccup in two different experimental conditions: in the absence of auditory stimulation (silent condition) and in the presence of a sound (hiccup or yawn) that matched only one of the two facial

gestures [in-sound condition]. Newborns revealed a strong tendency to match the facial gesture with the correspondent sound, as testified by increased looking times to the sound-matched facial gesture in the in-sound condition. Conversely, no visual preference emerged in the silent condition. Our results show that as soon as birth, newborns seem to be able to detect, discriminate and match facial gestures and non-speech sounds. Next step will be to assess whether this early ability is present also in the absence of audio-visual temporal synchrony.

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PA-032
Breaking the rules: Nine-month-old Italian-learning infants detect violations of gender and singular/plural morphological distinctions

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Learning a language requires more than simply building a vocabulary; infants must also learn the morphological regularities of their language. While some research shows that infants begin to understand that words can be comprised of roots and morphemes at 11 months, other research with English-learning infants shows that the distinctions marked by those morphemes are mapped to conceptual distinctions relatively late.

Yet, in English, the noun morphology is not as robust as in some other languages. For example, Italian has a robust inflection morphology that marks nouns with a gender and a singular/plural distinction (e.g., *il ragazzo* – the man; *i ragazzi* – the men; *la ragazza* – the woman; *le ragazze* – the women). We asked whether infants learning Italian understand morphological distinctions at 9 months.

We tested 9-month-olds ($N = 12$) using an EEG picture-word priming paradigm. Infants saw images of faces that varied in gender and number of faces (i.e., one male, two males, one female, two females). Each image was presented with a label that was congruent or incongruent --a mismatch in either the gender or the number morphological distinction. We hypothesized that a mismatch response would result if infants detected the incongruent morphology.

Infants demonstrated a robust N400 when the morphological markings of a label were incongruent. Our findings provide evidence that a negative potential is present for morphological violations, even in young infants. Italian-learning 9-month-olds are sensitive to the morphological distinctions present in their language.

PA-033
If we belong to the same linguistic group, I am more likely to predict your actions. An EEG study with 6-month-old infants

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As adults, we are constantly inferring others' mental states to interact with other people, even if these contradict our own beliefs. This interaction is influenced by the group to which other people belong (Bourgeois & Hess 2008). It is known that preverbal infants can use others' representations of the world to predict others' actions and intentions (Kovács et al. 2010; Southgate & Verneti 2014). Other studies show that from the early months of life there is a preference to interact, imitate and affiliate with those who speak one's native language (Kinzler et al. 2007; Buttelmann et al. 2013). In the current project, we asked whether 6-month-old infants ($N = 12$) have the capacity of predicting an agent's actions irrespective of the language he speaks, or only when he is from a linguistic in-group. We measured (EEG) changes in power in alpha band oscillations, reflecting predictions of others' actions prior to their performance (Southgate & Begus 2013). The results show that infants only predicted the agent's actions based on his beliefs when he presented himself in the infants' native language (Catalan or Spanish), and not when he used a foreign language (German). This suggests that the selectivity on predicting in-group members' actions emerges very early in ontogeny and it is highly associated with the cultural learning.

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PA-034
Modulation of attentional orienting by threat-relevant stimuli in infancy

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Many studies support the idea that humans are biased to detect threat rapidly. In particular, capture of attentional resources by threat-related stimuli has been reported in adults but also in infants, who have no experience with these stimuli.

However, how detecting such stimuli influences the spatial orienting of attention remains unknown. Still, spotting a threat in the environment should automatically activate information about its location in order to elicit a proper reaction.

We used an emotional version of the cuing paradigm, adapted to infants. Peripheral cues were pictures of threat-relevant and threat-irrelevant stimuli (snakes and flowers), followed by a bilateral target. On each trial, we recorded latencies of the first saccade at the onsets of the cue and of the target, and the direction of the first saccade toward the target.

Results revealed that infants' attention shifted faster towards the cue when it was a snake than when it was a flower, supporting attentional capture by threat-relevant stimuli. Moreover, the nature of the cue influenced the direction of the infants' first look toward the target: While infants' first saccade was more often oriented to the cued than to the uncued target when the cue was threat-irrelevant, they oriented as much to the cued as to the uncued target when it was threat-relevant. Most probably, detecting a curvilinear shape induced a broadening of attention, so that infants were vigilant to both sides of space. These results provide evidence that humans have an evolved, inborn predisposition to detect threat in their environment.

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PA-035
How infants and adults tell the front from the back of a novel agent?

Mikołaj Hernik

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This study tested whether human infants and adults assign body-direction to a novel agent rather on the basis of its actions or its novel morphology. Participants watched a series of animations of a novel agent (elongated box-like shape locomoting with caterpillar-like motion) moving from the center to the left or to the right side of the screen. During familiarization the agent's movement was fully or partially visible. The agent had a blue "x" on its leading end [fore-feature condition], on its trailing end [hind-feature condition], or it had plain ends [baseline no-feature condition]. On four test trials the movement was occluded. The agent [now always with the "x" on one end] was shown only at the center before it started to move, and 2 seconds later when it re-emerged on the side. Action anticipation was assessed through first saccade to destination before the agent's arrival. Thirteen-month-olds in fore-feature condition anticipated at chance level. Eighteen-month-olds anticipated to the correct location significantly above chance in the fore-feature condition, but significantly below chance

in the hind-feature condition, and at chance in the baseline no-feature condition. Adults anticipated above chance in all the three conditions, but in the hind-feature condition they anticipated less correctly than in the fore-feature condition and as correctly as in the baseline. Thus, both 18-month-olds and adults tended to assign front to the novel agent on the basis of the end-feature despite its novelty and regardless of the feature's location relative to motion during the agent's previous actions.

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PA-036
3-5-year-olds fast map and retain functions as well as object labels but actions win the race

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To become skilled artefact users, children must learn the actions and functions associated with them. We investigated young children's ability to map and retain long-term an action, function and name associated with a novel artefact. This followed brief incidental exposure to the artefact's use, involving one simple action, producing one simple function. The methodology was designed to distinguish action from function learning. In Experiment 1, 3- and 5-year-olds ($N = 144$) performed significantly above chance on action, function and word comprehension tasks (~80% correct), a week after 2 exposures to the novel action/function/word. This suggests children can retain actions and functions long term, following minimal exposure, in a similar way to word learning. In Experiment 2, 100 3-year-olds were exposed to just one demonstration of the novel action/function/object label. Retention of the object-action link was significantly above chance (65%) and significantly greater than the retention of the function-object link (30%) and the word-object link (15%). This suggests that children distinguish between an action-object link and a function-object link and their recognition of actions is superior. Finally, in Experiment 3, 4-year-olds ($N = 128$) performed well on an action production task, a week after brief exposure. In contrast, their performance on a word production task undertaken immediately after exposure was poor (~5% correct).

PA-037

Detecting the boundaries of newborns' Peripersonal Space

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Peripersonal Space (PPS) is the portion of space immediately surrounding the body, which mediates all physical interactions with the adjacent environment. PPS is conceived as a multisensory-motor interface integrating tactile, visual and auditory stimulation occurring near the body (Teneggi et al., 2013). The essential multisensory feature of PPS has been investigated in adults through a dynamic audio-tactile interaction task able to detect the boundaries of adults' PPS, determined by a significant decrease in RTs to a tactile stimulus paired with an auditory stimulus when the latter was perceived within the PPS (Canzoneri et al., 2012).

The aim our study was to determine the existence and boundaries of newborns' Peripersonal Space (nPPS). We implemented an infant adaptation of the adult audio-tactile interaction task. Newborns attention was attracted to the centre of the screen by a flashing light. They were then presented with a 2s lasting pure tone, paired with a tactile stimulation. Then, two peripheral targets appeared. Saccadic latencies to orient towards the targets were measured as reaction times (RTs). The procedure was repeated 30 times, using 3 tones with different intensities, presented in randomised order.

We hypothesized that – should nPPS be similar to PPS – newborns' RTs should present a significant shrink when the tone is perceived within nPPS boundaries. Preliminary results confirm our hypothesis showing that newborns' RTs decrease at the same space point as adults' ones. This suggests human beings at birth seem to already possess a PPS, which dimensions seem to overlap with adults' PPS ones.

PA-038

Step in time: Walking training reduces the gap in rhythm production skills between crawling and non-crawling infants

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Whilst infants show some tempo-flexibility in their first year of life, they do not seem able to synchronize their movement to music until they reach the pre-school years. We ask whether experience of bipedal locomotion is critical in the development of rhythm

production skills. Participants were 22 pre-walking 10-month-olds. Infants experienced a pre- and post-test bell ringing to music task. Accuracy of infant bell ringing to music was recorded using surface electromyography. Between pre- and post-test, infants took part in a five-minute training session of supported walking on an infant treadmill. Contrary to our hypothesis, infants did not show an overall improvement in accuracy from pre- to post-test [$F(1, 21) = .396, p = .535$]. However, we were interested to see if improvement was dependent on individual motor development, predicting that infants who were more motorically advanced may not gain from the treadmill training, and that this possible ceiling effect may mask positive effects of the training on those infants who were further from independent walking at test. We divided the group by whether the infants could crawl (demonstrate quadrupedal locomotion) or not. Results show that non-crawlers were significantly worse than crawlers at pre-test [$F(1, 21) = 7.669, p = .012$], but showed equal performance at post-test [$F(1, 21) = 1.466, p = .240$]. The results suggest that walking training may help level the playing field between the two groups, with non-crawlers benefitting where the more motorically advanced crawlers do not.

PA-039

How does social touch modulate arousal states? An investigation in early development

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Caregiver-infant interaction through touch was shown to have long-term effects on child's cognitive development but the mechanisms are poorly understood.

Our aim is to investigate how social touch (slow gentle caressing) affects arousal states in young infants. Animal and human studies suggest that touch modulates arousal states. Heart rate is a marker of arousal states, and heart rate deceleration is associated with lower arousal (Olbrich et al., 2011). In a recent work, heart rate decelerations were observed in 9-month-old infants only when they experienced social touch (slow stroking -3cm/s) compared to non-social touch (Fairhurst et al., 2014). In this study we aim at bringing additional evidence that slow touch decreases arousal by using two measures, heart rate and speed of orienting to peripheral stimuli.

We tested 6-month-old infants using a between-group design (slow/fast touch). We measured heart rate and saccadic reaction time (visual marker of arousal) while infants performed a visual orienting task, where their speed of re-orienting from a central fixation to a peripheral target was measured. During this task the experimenter strokes the infants' back with a paintbrush either at a slow [5 cm/s] or at a fast speed [> 10 cm/s] in blocked trials.

Overall, infants showed faster heart rate and reaction times in the touch conditions compared to the no-touch condition, with no effect of slow versus fast touch. Since this does not replicate Fairhurst et al., we are currently testing 9-month-old infants to inquire about potential for developmental effects.

PA-040
Explaining prepares five-year-old children to ask efficient questions

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We investigated whether prompting 5-year-olds ($N = 63$) to explain some observed evidence improves their ability to ask efficient questions. Children were assigned to one of three experimental conditions: Training with explanation, Training without explanation, or No training.

Test. In all conditions, children were presented with Loma, a monster, and with 16 cards representing treats that Loma had tried. Children had to figure out what kind of treats gave Loma a tummy ache by asking yes/no questions.

Training. In the Training conditions, children were presented with four monsters, and for each monster they were shown four treats that gave him/her a tummy ache, and four that did not. In the Training with explanation condition, children were asked to explain why particular treats gave the monster a tummy ache. In the Training without explanation condition, children were only asked to point to the treats that gave the monster a tummy ache. The training was designed to help children identify relevant features (i.e., cupcakes, cherries, sprinkles) and to equate the prior probabilities of two hypotheses about which treats lead to tummy aches (i.e., cupcakes, cherries and sprinkles).

We found that explaining prepared children to ask more efficient questions by promoting the identification of the most informative, abstract features available. This facilitating effect did not depend on the accuracy of children's prompted explanations. Merely being exposed to the training (without explanation) did not improve children's performances over the no training condition.

PA-041
The effects of psychological distance on future-oriented reasoning in preschoolers

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Data suggest that children's future-oriented reasoning is superior when they adopt the perspective of another child. For example, Bélanger et al. (2014) showed that children were more likely to acknowledge that a peer would prefer coffee to Kool-Aid when he was all grown up, than to make this same prediction for themselves. This finding is consistent with the claim that "distancing" from one's current perspective facilitates future-oriented reasoning. If so, then performance on Bélanger et al.'s "preferences" task should be higher as social psychological distance from the self increases and, conversely, lower, as distance decreases. To test this hypothesis, we manipulated social distance by asking children to answer for a child who was described as being similar or dissimilar to them (Study 1), and familiar (i.e., friend), or unfamiliar to them (Study 2). For both studies, performance was also compared to children's reasoning about their own future preferences (i.e., no social distance), as in Bélanger et al.'s task. Despite replicating Bélanger et al.'s finding that children reason more accurately about another child's future preferences than their own, $F(1, 45) = 14.70, p < .001$, Study 1, $F(1, 66) = 4.29, p < .05$, Study 2, performance did not vary as a function of levels of similarity or familiarity. These findings suggest that while increasing social psychological distance by reasoning about a generic other (as compared to self) improves children's future-oriented thinking, more nuanced dimensions of social distance (e.g., "similarity") do not.

PA-042
Preschoolers' explanatory reasoning and sustained shared thinking

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The caregiver-child interaction is a central quality dimension in early education. One interaction technique has been identified as especially effective with regard to children's educational progress: sustained shared thinking (SST). SST is a form of cognitive cooperation and implies active participation of all interacting partners and it

targets at a joint mental problem solving, disambiguation, and evaluation. The aim of the present research was to examine how SST speech acts influence children's speech behavior and explanatory reasoning. Using a standardized experimental setting, we explored the question if and in which way the use of SST speech acts by educators would allow children to participate more intensely and in a more complex way in caregiver-child dialogs. To this aim, we examined the verbal behavior in children aged 2 to 6 years ($N = 38$) in relation to causal questions and statements in 1:1 situations with their teachers. The results suggest that using SST speech acts directly influences the verbal behavior and explanatory reasoning of children and that this effect is not moderated by age, socioeconomic status and children's cognitive abilities.

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PA-043
Argumentation from evidence: Preschoolers' causal explanations inform their evidence generation

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Recent research on causal learning suggests that preschoolers are sensitive to evidence characteristics [Schulz & Bonawitz, 2007], they make interventions on their surroundings to gain specific information [Cook, Goodman, & Schulz, 2011], and their interventions are in line with their causal explanations [Legare, 2012]. Present study investigates preschoolers' counter argumentation competence by presenting them false causal claims; and observing their causal explanations and spontaneous evidence generation in response to these false claims. Children were presented with a light box which is activated when certain objects are put on it [Gopnik & Sobel, 2000]. The objects varied in several physical features and the deterministic cause of the light was having a sticker on the bottom. During the study, children found out that the sticker was the cause through self-exploration. After children formed the belief that the sticker was the cause, they were presented with false causal claims, e.g. "I think the blue ones make it light up!" Children's causal explanations and evidence generation behaviors were coded. Preliminary results suggest that children's causal explanations inform their evidence generation distinctiveness. Children who accounted for both of the relevant causal features (e.g. color and sticker) were the ones who generated the most distinctive correct evidence. They were followed by children who only referred to one feature in their causal explanations. Lastly, children who did not make any causal explanations or who made incorrect causal explanations generated the least distinctive evidence. These results indicate children's causal explanations are informative of their evidence generation behaviors.

PA-044
The use of transparent surfaces in boundary-based spatial mapping

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Many studies have shown that animals and humans alike navigate by environmental geometry [Cheng et al. 2006]. Neurophysiological and neuro-imaging studies have suggested that such behaviors may be rooted in the hippocampal mapping environmental boundaries [O'Keefe & Burgess, 1996; Lever et al. 2002]. While boundary-based navigation has been widely documented, the factors that define a surface as a boundary have yet to be determined. Previous studies have begun to address this question by showing that children map space using even low visual-contrast, subtle layouts, as long as they are extended on the ground plane and three-dimensional. In contrast, children are insensitive to the spatial layout of two-dimensional forms and freestanding objects [Lee, Spelke, 2008, 2011]. In the present study, we minimized the visual information provided by these "boundaries" by testing children's use of transparent surfaces. Children ranging from 2.5-7 years old were asked to search for a hidden object located in one corner of an arena following disorientation. In Exp. 1, children were tested in a rectangular arena consisting of clear, transparent acrylic walls. In Exp. 2, white, opaque panels were arranged to create a segmented rectangular shape of the same size, a control condition in which younger children have been shown to succeed [Lee et al., 2012]. We found that until 4 years of age, children failed to reorient by the transparent surfaces, while all age groups succeeded in using the opaque surfaces. We discuss the implications of this developmental change on the neural mechanisms underlying boundary-based spatial mapping.

PA-045**The effect of parental emotional awareness on children's ability of metacognitive regulation**

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Metacognitive regulation requires individuals' intentional regulation while coping with negative emotions. Having conscious awareness about regulating emotions is the key concept of metacognitive regulation. In that sense, parent's awareness of their own emotions is hypothesized to have an impact on to what extent children consciously regulate their emotions. This study aimed to examine the role of parental emotional awareness on their child's metacognitive regulation skills. Families having child aged from 8 to 10 were visited at home. We visited 30 families, yet only the data of 11 families were coded so far. Semi-structured interviews about their awareness of sadness with mothers and fathers were conducted. Additionally, we interviewed with the children regarding their coping strategies in the face of a sad event, which they had actually experienced. Parents' emotional awareness was rated using a 5-point Likert scale (1 = not aware, 5 = highly aware) by the researchers. Children's ability of metacognitive regulation was rated, by using a 3-point Likert scale (1 = no regulation, 2 = little awareness about regulation, 3 = high awareness with using cognitive words), as well. Researchers reached a consensus on coding. We plan to make regression analysis once all codings are completed, but only correlation analysis was conducted for now. Preliminary analysis revealed that maternal ($r = .36, p = .14$) and paternal ($r = .22, p = .27$) emotional awareness were positively correlated with child's metacognitive regulation skills. Results are promising in showing that parental emotional awareness would have an impact on their child's metacognitive regulation, as predicted.

PA-046**Did you see the milk in the bathroom? The effect of scene semantics on eye movement control during development**

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Would you look for the milk in the bathroom? Probably not, because adults are effective scene searchers. When studied in the laboratory, adults are presented with scenes containing an object that semantically either fits or does not fit into the scene context [e.g., shampoo vs. milk in the bathroom]. The observers' gaze dwells longer on objects that are incongruent reflecting their prior knowledge. When does this semantic congruency effect emerge during development? To answer this question, we recorded eye movements of three-year olds and adults ($N = 8$ each) during a visual search of photographs of daily-life scenes in an entirely gaze-contingent paradigm. The search target was present in 29% of the trials that served as fillers. In the remaining trials, the scene did not contain the search target, but an object that was either semantically congruent or incongruent with the scene. We found a trend for an increase of the semantic congruency effect in dwell time with age, when comparing three-year olds to adults, but also when considering three-year olds alone. This effect is driven by a larger number of fixations on the critical object rather than a longer duration of fixations. These preliminary findings imply that children by the age of three are not as sensitive as adults to semantic incongruency in scenes, but that this age might mark an important step in the development of scene knowledge. Future research should aim at replicating these findings using different tasks and other measures of scene knowledge for further validation.

PA-047**The development of visual working memory capacity for biological movements and its relations to theory of mind in Chinese children**

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Working memory capacity has been proposed as the foundation for a range of intelligent behaviors and general cognitive ability. Recently, working memory studies have documented that human biological movements [BM] stimuli are stored

independently from colors, shapes, and locations. However, no one have investigated the developmental trajectory of working memory capacity for BM. Here, in study 1, we used the change detection paradigm, testing the working memory capacity for BM in Chinese 3-, 4-, 5-, 6-, 9-year-olds and adults. We found that performance on the task improved significantly with age and 9-year-olds reached adult levels of approximately three to four items. In study 2, we further examined the relationship between working memory capacity of BM and theory of mind (TOM) understanding in preschoolers. Results showed that children's TOM was positively correlated with their working memory capacity of BM, independent of their age, revealing the synchronicity of development in some degree. Specifically, at 4-year-old, children who have the ability to detect more items of BM performed better in TOM as well. However, no such significant correlation between working memory capacity of BM and TOM was found at 5- and 6-year-olds. In contrast, the correlation between working memory capacity of colors and TOM was not significant in another group of 4-year-olds. In conclusion, our findings revealed the fast development of working memory capacity of BM in Chinese children, and the positive relation between working memory capacity of BM and TOM indicated the important role of biological movements working memory in social interaction.

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PA-048
The development of time-based event expectancies in school-age children

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The ability to form time-based event expectancies is the most important determinant of anticipative behavior and has an impact in many types of interaction environments, such as verbal communication and human-machine interaction. Little is known about the development of time-based event expectancies during childhood.

Here, we used a binary choice response task to investigate the formation of time-based expectancy and its underlying mechanisms in school-age children. First, eleven school-age children (average age: 9 years) and eleven younger adults (average age 27 years) had to indicate the left or right direction of a target stimulus, which was predicted by long or short foreperiods in 80% of the trials. We found that contrary to adults, in school-age children the formation of the time-based event expectancies was restricted to the relatively shorter foreperiod. In the second part of the experiment,

the formerly short foreperiod was replaced by a new one, which was longer than the formerly long foreperiod, and the target direction was not predictable based on the foreperiod duration anymore. The school-age children responded after the shorter foreperiod faster to the target that had previously been frequent at the formerly relatively shorter foreperiod, suggesting that the children formed their time-based event expectancy according to relative duration.

Our results indicate that the ability to form time-based event expectancies is developed in school-age children. However, it seems that in children shorter foreperiods are more optimal to make temporal predictions.

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PA-049
Automatic and effortful integration processes in spatio-temporal memory

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Previous studies imply that the binding of what, where and when is an effortful process. In the present investigation, we examined the mental effort of memory binding tasks with different complexity levels. The sample included 55 children between the ages of 8 and 11 years. The applied method measured spatial and verbal memory components separately and jointly. The experimental tasks consisted of three single-binding tasks (binding of what and where; what and when; and where and when) and a combined-binding task (integration of what, where and when). In addition to the experimental tasks, executive function (verbal and design fluency) and attention (Bells test) tests were also administered. Our results show links between attention and executive capacity and verbal temporal binding abilities. In sum, while spatial sequential binding is an automatic process in memory, verbal order organization and the integration of double temporal information (spatial and verbal) rely on executive functions and conscious attention.

PA-050

The anticipation of other's actions in relation to autistic traits: An EEG study

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The mirror neuron mechanism (MNM), which becomes active during action execution and action observation, is considered to contribute to the development of social and communicative abilities. However, the functional role of this mechanism is still hotly debated. The present study investigated whether the MNM becomes activated already prior to the onset of observed actions when, on the basis of contextual information, the occurrence of the action was anticipated. If so, this would suggest a specific role in action anticipation. Additionally, its relation with individual differences in autistic traits (AQ; Autism spectrum Quotient) was examined. The current study included two EEG experiments with typically-developed participants. In the first experiment, EEG recordings were made during the observation of video clips depicting hand actions. In the second experiment, recordings were made during real-life interactions. Crucially, in both experiments, contextual cues were manipulated such that the occurrence of the actions could either be predicted or not be predicted. In all action observation conditions (video and real-life), a significantly reduced power in the sensorimotor alpha band (mu rhythm; 8-13 Hz), which presumably reflects MNM activation, was found during action observation. However, no MNM activation was found prior to the onset of observed actions. Furthermore, no significant correlation was found between the extent of mu rhythm suppression and AQ-scores. The current findings do not provide evidence for a role of the MNM in the anticipation of upcoming actions of others, nor do they support a relationship between MNM activity and autistic traits.

PA-051

Is gamma-band activity a signature of communication-induced object representations in infants?

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According to behavioral data, 12-month-old infants expect a referent object when following a point to an occluded site (Behne, Liskowski, Carpenter & Tomasello, 2012; Csibra & Volein, 2008). Neurophysiological studies suggest that the representation of an object that becomes occluded correlates with bursts of oscillatory activity in the gamma-

band in temporal areas (Kaufman, Csibra & Johnson, 2003; Kaufman, Csibra & Johnson, 2005). In the current study we asked whether gamma-band oscillations can also be induced by pointing to an occluded object.

We recorded EEG on 32 channels as 12-months-old infants first watched short video clips of objects disappearing on scene, or being hidden behind an occluder. In a preliminary analysis ($N = 9$) we found an increase in gamma-band activity in the 100 ms after the object is occluded, in contrast to removed, at Fz ($p = 0.014, \eta^2 = 0.553$) and T8 ($p = 0.012, \eta^2 = 0.562$). Subsequently, the infants watched an actor pointing behind the occluder. Our preliminary analyses ($N = 8$) does not support the notion that communicative cues lead to gamma activation. We found a significant decrease, instead of an increase, in gamma-band activity in right frontal areas during pointing in comparison to baseline ($p = 0.012, \eta^2 = 0.615$). We discuss two possibilities: 1) Gamma-band activity may not be a signature for communication induced object representations; 2) methodological limitations of the current design. To further investigate these possibilities we are currently running a revised paradigm.

PA-052

Socio-cognitive skills in children with agenesis of corpus callosum

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Children with agenesis of the corpus callosum (AgCC) with normal range of intelligence show to have deficits on a number of fields related to complex cognitive processes, especially in the social domain. The disruption in callosal connectivity provides impairments in nonliteral language comprehension, humor, emotion understanding, and social reasoning. However, little known about the development of potential emotional and mentalizing functioning deficits in AgCC contribute to the social development. This study investigated the complex set of socio-emotional skills including emotion recognition, mind reading, executive function, working memory, false belief tasks and behavioural symptoms assessed by parents. We examined children with isolated corpus callosum agenesis at age of 6-8 years and typically developing children who were matched by IQ and age. The findings show specific impairments in social and complex emotion recognition and mind reading tasks in children with AgCC comparing to typically developing children. However there was no significant difference in the cognitive domain of working memory and executive function. The findings support the specific role of the corpus callosum in higher social functions.

PA-053

Statistical associative structure changes with age

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The studies reported here are part of a general attempt to survey relationships between the statistical properties of large linguistic corpora and the statistical properties observed in individual language behavior.

Materials and methods:

Existing data bases were reanalyzed with information theory inspired measures. For the associative corpora, dictionaries of Lengyel (2008, 2010) were used, with responses of 2000 subjects of 10-14 and 18-24 years of age to 200 Hungarian words. Some parameters of this distribution were compared to frequencies in a 800 million tokens based Hungarian corpus (Moss, 2006, Kornai et al, 2006)

Results:

1. Increase in the correlations between corpus statistics and individual statistics with the increase of language experience. In nouns the corpus frequency was related to associative entropy, and the relationship got stronger with age [$r = 0.13$, vs. 0.37]. This statistical relationship was part of speech dependent, it did not hold for Verbs.
2. General overlaps in associative hierarchies were more dense in younger age.
3. Hierarchical cluster analysis over selected nouns (kinship related terms) indicates that the associative structure reflects a more refined lexical memory with increasing linguistic and cultural experience.

Conclusions:

It is worth to study the relationships been corpus based and individual lexico-statistical data to understand the changes of internalized semantics. There is an overall decrease of unspecified overlaps and an increase of cultural conformity with age. The comparisons also reveal challenging differences in the representation of Nouns and Verbs.

PA-054

The affection of socioeconomic status on adolescents' cognitive functions

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We conducted a research that aimed to explore the differences of cognitive functions between adolescents with low and higher socioeconomic status. It is known that socioeconomic status (SES) has influence on mental and physical health, cognitive ability and academic performance. Prefrontal cortex thus executive functions has long postnatal development hence early childhood experience could influence it (Lawson, 2014). Farah (2009) found correlation between SES disparities and language, and executive functions in children. Mezzacappa (2004) revealed a strong correlation between SES and a process that is called executive attention. Executive attention is one of the three components of attention in the Attention Network Test (ANT) paradigm. In our study we tested adolescents whose prefrontal cortex almost finished the development. The participants ($N = 40$) was picked from a normal high school ($N = 20$) and a caretaker organization called Faág Baráti Kör Egyesület ($N = 20$). Adolescents were at the age of 14 to 17. Executive functions were established by the Wisconsin Card Sorting Test (WCST), Stroop Test and the Tower of Hanoi tasks. The attention was assessed by the Toulouse-Pieron Test. In addition, we measured the children's reading comprehension too. There was significant difference between the low and higher SES groups, particularly in attention and reading comprehension.

PA-055

Insights from children's drawings: Role of semantic features in the representation of arithmetic problems

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Recent work has shown that the semantic nature of the elements present in arithmetic problems can promote different types of semantic encoding and thus different kinds of representations (Gamo, Taabane & Sander, 2011; Rapp, Bassok & Holyoak, 2015). In order to further specify such interpretative processes, we created problems which could be solved using two distinct strategies, and hypothesized that

the nature of the quantities (ordinal quantities versus cardinal quantities) described in the problems would affect the nature of the representations created and therefore the choice between these two strategies. Problems with ordinal quantities (e.g. height, duration) are believed to promote an ordinal representation compatible with a comparison strategy, whilst cardinal quantities (e.g. number of elements, weight) are believed to promote a cardinal representation, favoring the use of a complementation strategy.

We tested this hypothesis with primary school children ($N = 80$, mean age = 11.0 years, $SD = .50$) by asking them to provide a numerical solution to the problems and to make a drawing of the situation described explaining how they found the solution. The results showed that the nature of the quantities significantly impacted both the ordinal versus cardinal features of the drawings and the kind of solving strategy used by the pupils. This provided further proof of the influence of semantic aspects on problem solving and confirmed that the nature of the representations themselves was affected, therefore implying that the access to a semantically incongruent solving strategy would require a complete semantic recoding of the situation.

PA-056
Learning to overcome inadequate intuitive strategies in arithmetic word problem solving

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The Situation Strategy First framework (Brissiaud & Sander, 2010) posits that children persistently rely on the situation described in an arithmetic word problem, thus forming intuitive strategies; such strategies are adequate to solve some problems (Si), whereas other problems may require the use of the relevant arithmetic knowledge (MA). It was observed that during Year 3, children progress further in solving Si than MA problems. This raises the issue of finding methods to foster the efficient use of arithmetic knowledge.

We thus introduced swivel situations, which, while maintaining the same underlying arithmetic structure, could intuitively be assimilated to MA transformation problems, but offer predispositions for a Si recoding as complementation problems. This was done by adding specific adjectives to the original wording, which could activate different semantic representations. Year 3 ($N = 144$, mean age = 6.82) and Year 4 students ($N = 146$, mean age = 7.83) had to solve swivel problems and their MA and SI counterparts.

The results confirmed that Si problems have a higher success rate than MA problems, but interestingly the swivel problems had a notably higher success rate

among Year 3 and Year 4 students than their MA counterparts. Preliminary results showed that the introduction of swivel problems in a training phase could attest for a steeper learning curve on arithmetic problem solving amongst Year 2 and Year 3 children. The introduction of such problems may facilitate the semantic recoding necessary to overcome the obstacle presented by MA situations.

PA-057
Unstable operational momentum effect at the stage of mastering counting principles

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Operational Momentum effect (OM) – underestimation of the subtraction results, and overestimation of the addition results, was evidenced both on symbolic and non-symbolic numerosities in age ranges from infancy to adulthood. It is claimed that OM results from the close link between numerical representations in the brain and the mechanisms of directing visual attention (eye saccades control, Knops et al, 2009). However, this effect may be in fact more complex (Fischer & Shaki, 2014), and may change, as the number representation updates from approximate to exact number system around the 5th year of life. Previous study (Haman, CDS2015) has shown that while asked to perform single unit addition/subtraction on large-numerosity set base (>5), preschoolers, both subset-knowers and CP-knowers (full mappers; LeCorre & Carey, 2007) show some form of OM, however for subset-knowers this manifests in acceleration of subtraction result selection in left-directed attention condition, and right-directed attention in addition, while in CP-knowers such effect is diminished, but classical OM (overestimation in addition, underestimation in subtraction) is revealed. Interestingly, either intermediate children (CP-knowers, non-mappers), nor older children, who started formal math training, show neither of these effects, while both effects may be again found in adults. In this poster we show systematic evidence for instability of the (non-symbolic) OM at the stage of acquiring counting principles, and discuss how this dynamics may be linked with the course of development of the number representations.



POSTER
SESSION B

PB-001**The social-cognitive basis of infants' communication about absent entities**Manuel Bohn¹, Josep Call^{1,2}, Michael Tomasello¹¹ Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany² University of St. Andrews, St. Andrews, UK

Humans interpret communicative acts within the context of the experiences they share with their interlocutors [Clark, 1996; Sperber & Wilson, 2001; Tomasello, 2008]. Recent evidence suggests that infants as young as 12 month of age use pointing to communicate about absent entities [Bohn et al., 2015; Liszkowski et al., 2009]. In these studies infants used the former location of an object to refer to the now absent object. The tacit assumption underlying this research is that infants do so because they take into account what their interlocutor experienced in a previous interaction.

The present study addresses this assumption empirically. During test trials, 12-month-old infants ($N = 80$) had the choice of pointing to less preferred visible objects on a plate or pointing to an empty plate where preferred objects previously were located. We systematically varied whether the adult from whom infants were requesting had previously experienced the former content of the location.

Our results show that infants referred to absent objects more often if the adult had experienced them in the now empty location previously. These results suggest that infants keep track of what they experience with others and what their interlocutors are likely to know based on these experiences. This supports the interpretation that infants' earliest form of intentional communication is deeply rooted in social cognition and interaction.

PB-002**Maternal uptake of infant pointing predicts subsequent pointing frequency**Ebru Ger¹, Nazlı Altınok², Ulf Liszkowski³, Aylin Küntay¹¹ Koç University, İstanbul, Turkey² Central European University, Budapest, Hungary³ University of Hamburg, Hamburg, Germany

Infants' frequency of pointing predicts their language development [Colonesi, Stams, Koster, & Noom, 2010]. However, predictors of pointing frequency are not as well known. One study showed that pointing frequency was determined mainly by

socialization processes compared to infants' own socio-cognitive abilities [Matthews, Behne, Lieven, & Tomasello, 2012]. Here we show the prevailing effect of maternal uptake as a socialization process on pointing frequency compared to infants' own fine motor and socio-cognitive abilities.

24 mother-infant dyads were examined at 10 and 12 months of age. Infants' pointings (both index and hand) and mothers' uptake of these pointings were assessed via the decorated room paradigm [Liszkowski et al., 2012]. Maternal uptake was categorized as sensitive if mothers' verbal and/or nonverbal responses were semantically relevant to the item infant pointed at, non-sensitive if they were irrelevant, and none if the mother did not provide any behavior. Percentages of these maternal uptake categories were taken. Additionally, infants' fine motor development and ability to follow points were assessed via the Mullen Scales of Early Learning [Mullen, 1995] and a point following procedure adapted from Mundy [2003], respectively. Results showed that the percentage of sensitive maternal uptake at 10 months significantly predicted the frequency of infants' points at 12 months, when controlling for the frequency of infants' points, Mullen scores, and point following scores at 10 months [$F(4, 19) = 5.069, p < .01, R^2 = .52$].

This study demonstrates the importance of socialization by maternal uptake on infants' pointing frequency above and beyond infants' socio-cognitive and motor abilities.

PB-003**Investigating 14-month-olds' expectations in social learning situations**Nadin Helbing¹, Susanne Grassmann², Sabina Pauen³, Stefanie Hoehl³, David Buttelmann^{1,4}¹ University of Erfurt, Germany² University of Zurich, Switzerland³ University of Heidelberg, Germany⁴ University of Bern, Switzerland

One of the most influential findings regarding infants' imitation was that 14-month-olds imitate rationally [Gergely, Bekkering & Király, 2002]. That is, they selectively imitate a model's choice of means to obtain a goal more when the model freely decided to use it [e.g., turning on a lamp with her head when her hands were free] than when she was forced to do by some physical constraint (using her head when her hands were constrained holding a blanket). So far, it is unclear what makes infants show this selectivity. We investigate the role of the violation of infants' expectations that others use the most effective means in this process by measuring infants' gaze behavior. Twelve- to 14-month-

old infants (final $N = 124$) are shown video clips, displaying the model, having her hands free or restrained, turning on a lamp with her head or hand. In addition to infants' looking time we record the dilation of infant's pupils and infant's shifts of gaze between different areas of interest. There are four conditions (within-subjects), combining all possible variations of conditions of constraints and means used. We expect to find longer looking times at unexpected events than at expected events. We further expect differences in the number of shifts between the modeled action and the model's hands, for example, a high level of such shifts when the hands were the expected means but the model violates this expectation by using her head. Data collection is still in progress but will be finished soon.

PB-004 Investigating the influence of communicative acts on belief attribution in infancy

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In communication theory, the prevailing view is that to understand a speaker's intentions, the hearer needs Theory-of-Mind-abilities. Song and colleagues [2008] investigated whether communication might change children's expectations about the actions of an agent who held a false belief. The 18-month-old participants saw how an agent put a ball in a box, left, and an assistant moved the ball into a cup. However, when the agent came back, the assistant told her that "The ball is in the cup" (informative condition) or "I like the cup" (uninformative condition). Analyzing children's looking times, the study found that children expected the agent to search the ball in the cup in the informative but not in the uninformative (more indirect) condition. However, recently Schulze & Tomasello [2015] found that even 18-month-olds understand indirect communicative acts.

Therefore, we wanted to replicate and extend Song et al.'s study. So far, we tested 34 children (mean age: 18 months, 21 days) in the two conditions described above. We found that children looked longer when the experimenter reached into the cup [$F(1, 30) = 6.646, p = .015$] and a tendency for longer looking times in the informative condition [$F(1, 30) = 3.623, p = .067$].

Since the utterance in the informative condition highlights the correct location twice, we will include two more conditions that either omit the searched-for item ("It's in the cup") or the item's real location ("The ball is nice").

We are careful to interpret our findings since data collection is still in progress.

PB-005 Four-month-old infants' object processing is facilitated by isolated human eye gaze

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From early on in life, another person's eye gaze biases infants' processing of objects in the environment. However, it has not been clarified whether this effect is restricted to the presence of an intact face or whether even isolated eyes affect infants' object processing. We presented an isolated pair of human eyes gazing towards objects or away from objects to examine four-month-olds' object processing by measuring event-related potentials. While the eyes were gazing towards the objects, a significantly enhanced positive slow wave was observed on fronto-central channels [$F(1, 23) = 4.444, p = .046$]. In response to the eyes gazing away from the objects, no slow wave activity was found. Since a slow positivity is discussed to reflect encoding processes, this suggests that enhanced memory encoding is involved when isolated eyes are cueing objects. When presenting the objects again, a significantly decreased Nc component [$F(1, 23) = 11.098, p = .003$] and a significantly enhanced Pb component [$F(1, 23) = 5.682, p = .026$] was found on fronto-central channels in response to the previously cued objects. Since the Nc component is associated with attention allocation to novel stimuli and the Pb component is discussed to reflect efficient stimulus processing, these results indicate that the previously cued objects were less novel to the infants and were processed more efficiently compared to the previously uncued objects. It is suggested that by an age of four months, infants' processing of the environment is affected by isolated human eyes.

PB-006**Susceptibility to ostensive communication culminates at 8-9 years of age**Lilla Pintér¹, Tamás Zétényi^{1,2}, Katalin É. Kiss¹¹ Research Institute for Linguistics of the Hungarian Academy of Sciences, Budapest, Hungary² Budapest University of Technology and Economics, Budapest, Hungary

We argue that children's hypersensitivity to ostensive communication is highest at the age of 8-9 years. This is based on two experiments, where children systematically give non-adult-like answers in sentence-picture matching tasks because they misinterpret every element of the visual stimuli as ostensive signals. We performed both experiments with several age groups, and found that the proportion of children misled by the apparent ostensive import of the stimuli was highest in the 2nd-3rd grades.

The first experiment tested the interpretation of sentences with exhaustive focus. We used focusless sentences as a baseline, e.g. "Grandma baked the chicken", which we did not expect to be rejected in case of non-exhaustive pictures showing e.g. "Grandma with both a baked chicken and a pie". However, many children considered these sentence-picture pairs false, arguing that it is not only the chicken that Grandma baked. This was particularly true in the group of 9-year-olds: here the proportion of rejections was 50%.

In the second experiment, children were shown pictures where every agent is manipulating an object, and there is an extra object, e.g., every girl is riding a bicycle, and there is a solo bicycle. When asked if every girl is riding a bicycle, many children answer: "No, not that one", pointing at the empty bicycle, which we attribute to the ostensive presentation of the visual stimuli. The experiment was repeated with age groups from 4 to 11-12. The proportion of non-adult-like answers was highest at the age of 8.

PB-007**Personal experience with the testing object reduces overimitation in harm-avoidant children**

Hanna Schleihauf, Sabina Pauen, Sabine Graetz, Stefanie Hoehl

Heidelberg University, Heidelberg, Germany

We investigated causal and individual factors underlying children's imitation of non-functional actions ["overimitation"]. We designed two experiments to test if children ($N = 72$, $M = 62.5$ months; $SD = 1.76$) overimitate when the irrelevance of the actions is highlighted.

In both experiments children observed two experimenters retrieve a reward from a transparent puzzle-box, one using causally relevant, the other using causally irrelevant actions. After each demonstration, children removed a reward themselves, with the number of causally irrelevant actions providing a measure of overimitation. Parents of children in Experiment-2 filled out the Junior-Temperament-and-Character-Inventory (JTCl, Goth & Schmeck, 2009).

In Experiment-1 children saw the inefficient strategy first, then the efficient strategy. Compared to a baseline, we found that five-year-olds overimitated in both phases of the experiment even though the puzzle-box including the reward location was completely transparent [$z = -3.79$, $p_{\text{Holm-Bonferroni}} < .001$, $d = -.57$].

In Experiment-2 we made the irrelevance of the actions even more obvious by presenting the efficient strategy before the inefficient strategy. The imitation of irrelevant actions after the inefficient demonstration was on baseline level [$z = -.068$, $p_{\text{Holm-Bonferroni}} = .946$, $d = -.01$]. However 11 of 28 children chose to switch from the efficient to the inefficient strategy. These children had significantly lower JTCl-Scores on the dimension Harm Avoidance [$t(26) = 2.29$, $p = .03$].

The results portend that personal experience with the efficient strategy reduces overimitation in harm-avoidant, but not in carefree children.

PB-008**Facial mimicry in 4-month-old infants: Effects of social signals and parental imitation**Carina de Klerk¹, Victoria Southgate^{1,2}¹ Centre for Brain and Cognitive Development, Birkbeck College, University of London, UK² Department of Psychology, University of Copenhagen, Denmark

Humans have a tendency to spontaneously and unconsciously copy or 'mimic' others' postures, gestures, facial expressions, and emotions. This mimicry plays an important role in communication and affiliation, yet little is known about its development. It has been suggested that mimicry is supported by associations between visual and motor representations of actions that are formed through correlated visuomotor experience. The present study investigated this hypothesis by assessing whether infants' facial mimicry is related to their parents' tendency to copy their facial actions. Thirty 4-month-old infants participated in a face-to-face play session with their parent from which the amount of parental facial imitation was coded to obtain an index of infants' opportunity to form associations between visual and motor representations of facial actions. Infants also observed movies of a model

performing facial actions [e.g. eyebrow raising, tongue protrusion, and mouth opening] while we measured activation of the corresponding facial muscles using surface electromyography (EMG). The direction of the eye gaze of the actress was manipulated [direct vs. averted] to assess whether, like in adults, mimicry is modulated by social signals in infancy. Preliminary analyses demonstrated that infants indeed showed more mimicry when they observed facial actions accompanied by direct, compared to averted gaze. If the ability to mimic facial expressions indeed develops through being mimicked by others, we furthermore expect infants who receive a higher degree of parental facial imitation to demonstrate higher levels of facial mimicry.

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PB-009
Do emotional cues lead to differential imitation in 18-month-olds?

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Recent research suggests that 15- to 18-month-olds can use emotional displays of others to influence their own imitative behavior, usually by showing a preference for reproducing positively emoted actions over negatively emoted actions [e.g., Repacholi, 2009]. We aimed at investigating infants' active selection when imitating differentially emoted actions. Therefore, we presented 30 18-month-olds with both positive and negative emotional displays directed to actions. We expected that infants' first actions match positively emoted actions more often than negatively emoted actions. Infants observed an adult performing two actions on each of four objects, presented consecutively. Using a within-subject design, one of the actions was emoted positively, the other action was emoted negatively. After each demonstration, infants were allowed to act on the objects themselves. We found a slight preference for imitating positively emoted actions over negatively emoted actions using t-test [$p = .08$]. However, only girls imitated positively emoted actions significantly more often than negatively emoted actions [$p < .01$]. Due to the within-subject design, our task was more difficult than previously used tasks. This may explain why we found only a trend in preferentially imitating positively emoted actions in the complete sample. Nevertheless, girls selected between differentially emoted actions and preferentially imitated the positively emoted action. Further research is needed to clarify this gender effect, e.g., to check if girls' ability to take account of emotional cues during action processing and production develops earlier than that of boys. Also, the specific effect of the emotions could be investigated by adding an emotionally neutral condition.

PB-010
Can infants learn a new word by “looking through” a speaker’s false belief?

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Southgate et al. [2010] found that toddlers can determine the intended referent of an ostensive point under false belief but that a verbal label played no role. We tested 10- to 20-month-olds who watched a puppet presenting pairs of novel objects to an agent. Infants watched three pairs of Tell-and-Test trials: Pointing-Tell, True-Belief-Tell, and False-Belief-Tell. In the Test trials, infants saw the previous two objects and heard the agent say, “Look! Look at the [dax/sefo/wug]!” We measured infants' eye-gaze [Tobii XL-T60]. For Pointing-Test, infants looked longer to the object the agent had labeled. In the True-Belief-Test, infants looked longer to the object that was in the box at the time of labeling. In contrast, in False-Belief-Test, infants looked longer to the object that was not in the box at the time of labeling. In experiment two, we examined the role of the label. We isolated the effect of labeling by changing the agent's instruction in the Tell trials to, “Look! Look at this!”. If infants access speaker intention only in pointing but not in labeling, they will show the same pattern in Test trials. Infants showed no preference in Pointing- and True-Belief-Tests, and the opposite preference in False-Belief-Test. Preverbal infants can map a novel label by correcting for a speaker's false belief but require the speaker to utter the label at the time of pointing. Our findings support a basic role for theory of mind in word learning, including the litmus test of false belief.

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PB-011
What does inter-tasks coherence reveal about theory of mind in infancy?

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It has been proposed that infants have a rich theory of mind by the end of the first year as revealed by violation of expectation tasks [Baillargeon, Scott, & He, 2010]. This rich interpretation is currently the subject of a hot debate [Heyes, 2014; Ruffman, 2014]. Among the leaner arguments is that infants' looking time patterns in these implicit tasks can be explained by the violation of behavioural rules or by reactions to perceptual novelty, and not to an actor's false belief. There are a number in ways in which these alternative proposals can be tested empirically. One approach has been to conduct longitudinal studies

to assess continuity in implicit and explicit measures of theory of mind. In this paper, we propose another approach, which is to assess the coherence of infants' performance on theory of mind tasks across paradigms. We administered two series of theory of mind tasks [intention, desire, true belief, and false belief] to 18-month-olds infants ($N = 53$), one series based on the violation of expectation paradigm and the other on active behavioral methods, such as imitation or helping. We reasoned that if these tasks are all measuring conceptual knowledge then performance on the VOE and on the interactive tasks should be related. The results indicated no significant relations between performance on the tasks for all four ToM constructs. Thus, the present findings seem to support lean interpretations of infants' performance on implicit theory of mind tasks based on looking time.

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PB-012
The role of mental state language in the transition from an implicit to an explicit Theory of Mind

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Mental state language is the first sign for an explicit understanding of the mind and is assumed to play a pivotal role in the child's construction of a Theory of Mind. There is some evidence for a predictive relation from infant joint attention to mental state language in the third year of life [Kristen et al., 2011], and for toddlers' mental state language predicting Theory of Mind at 4-5 years [Brooks & Meltzoff, 2015]. In the present longitudinal study of $N = 88$ children, we investigated the predictive relations between a whole set of measures of infant psychological reasoning and mental state language at 24, 30, and 36 months, assessed by a parent questionnaire. Goal-encoding [Woodward, 1998] at 7 months, and declarative point production at 12 months were significantly correlated with later mental state language, when sex and general language ability at 30 months was controlled for. Other predictors of Theory of Mind [implicit false belief, intention-based imitation, understanding subjective desires] were not correlated with mental state language. Mental state language, in turn, was correlated with explicit Level-1 perspective judgment at 30 months, and with false belief understanding in a moral context at 60 months, independently of sex and general language. There was, however, no evidence for a mediating role of mental state language in the relation between implicit Theory of Mind in infancy and later explicit Theory of Mind. The findings are discussed with regard to theoretical accounts of Theory of Mind development.

PB-013
Do 14-month-old infants need communicative cues for automatic level-1 perspective-taking?

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Adults and infants have been suggested to automatically take the perspective of a static avatar oriented to a scene [Samson et al., 2010; Kovács et al. 2010]. Alternative explanations suggest that endogenous spatial cueing effects could account for the findings [Santiesteban et al., 2013]. In infant studies, however, it is controversial whether efficient endogenous cues have to have an ostensive-communicative property [Senju and Csibra, 2008; Daum et al., 2013], or static postures suffice [Hofsten et al., 2005]. In an eye-tracking paradigm [similar to Csibra and Volein, 2008] we compared different cues on efficiency in orienting attention [latency] and level-1 perspective taking [the expectation that somebody sees something] for 14-month-olds. We found a significant latency effect for a cued vs. non-cued object in videos where a person pointed while saying "ah" [communicative], but not where a still person in profile was just looking [non-communicative] to one of two occluders, which uncovered an object on one side subsequently [$t(15) = -2.53, p = .012$ (one tailed)]. In Experiment 2 [$N = 10$, data collection ongoing] a fixation cross replaced the person after the cue. We replicated the latency effect for the communicative condition. Testing level-1 perspective taking revealed that only in the communicative condition infants looked longer to the cued but empty side than to the non-cued empty side [$t(9) = 2.64, p = .014$ (one-tailed)]. Our results demonstrate that the ability of level-1 perspective taking depends on communicative signals. One possible interpretation is that automatic perspective taking seen in adults is an emergent ability based on infants understanding of communicative cues.

PB-014**Understanding privileged access and the development of mentalistic action explanations**

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During the last forty years there has been an explosion of research into the naïve theory of mind (ToM) of primates, children and adults. This ToM research has been linked to the study of folk behaviour explanations in which mental states (e.g. beliefs, desires) play crucial roles. The present poster reports two experiments on the development of mentalistic action explanations and understanding of privileged access to mental states. The specific research questions are the following: What is the relationship between understanding privileged access to mental states and theory of mind? When and how does the child acquire the attribution of privileged access to mental states? When and how does the child generate and evaluate mentalistic action explanations and predictions? In our first experiment, we used two modified stories from the classic Bartsch and Wellman (1989) material in order to examine the development of generation of mentalistic action explanation and its relationship to understanding privileged access. In the modified versions of the experimental questions we specifically targeted the ascription of privileged access to mental states by preschool children. The two stories differed in the direction of reasoning required from the child's part. In the second experiment, we again modified one story of Bartsch and Wellman (1989) in order to reveal the understanding of privileged access in a task where the child had to understand the protagonist's first-person verbal report. In doing so the child was required to evaluate action explanations.

PB-015**Infants attribute an agent's sociomoral behavior to its "insides"**

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UMass Amherst, USA

Adults' social reasoning is biased by an implicit belief that internal properties give rise to people's outward appearance and observable actions. We explored the developmental foundations of this bias by examining whether 13-month-old infants automatically associate an agent's sociomoral behavior with its 'insides'. Infants repeatedly witnessed an agent's goal being helped or hindered by two partially

transparent characters that possessed contrasting internal and external features (e.g., one with a red 'hat' and red 'insides' vs. one with a yellow 'hat' and yellow 'insides'). Infants were then given a choice between two scrambled versions of the characters to see which they would rather play with—one that possessed the same color of the helpful character's 'insides' or one with the same color of the helpful character's 'outsides'. A second condition examined whether disrupting the causal connection between an agent's 'insides' and its behavior mitigates the effect. Our results indicate that a majority of infants associated an agent's social disposition to its internal properties, a possible precursor to later causal understanding.

PB-016**Naïve chicks prefer to approach hollow objects**

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Sensory and cognitive predispositions help living beings to cope with their environment, by orienting approach and avoid responses to relevant stimuli (Versace and Vallortigara, 2015). It is not surprising hence to observe that, since the early stages of life, species that require parental care, such as human and non-human primates and chicks of the domestic fowl, prefer stimuli that happen to be more similar to animate social partners (Vallortigara, 2012; Rosa Salva et al., 2015). Studies on human infants showed that 8-month-old babies might possess expectations about the biological properties of animate and agentive entities (Setoh et al., 2013) but it is not clear whether previous experience with animate entities that possess innards (e.g. care-givers) has generated those expectations, or whether they arise spontaneously. We reasoned that naïve chicks of the domestic fowl (*Gallus gallus*), who are spontaneously attracted by entities which show cues associated with animacy (Vallortigara et al., 2005; Rosa Salva et al., 2010; Mascalzoni et al., 2010; Johnson and Horn, 1988), might be a convenient subject to identify whether the property of being filled/hollow triggers unlearned preferences for "social" partners. To this aim we tested preferences of naïve chicks for hollow and closed cylinders of the size/colour that elicit filial responses. We documented an unlearned attraction for hollow stimuli that was modified through imprinting experience. Further experiments clarified that hollow objects were attractive by means of depth cues such as darker innards, more than as a hiding place. Our study documents the attraction of inexperienced chicks for hollow objects, and shows how a relatively brief exposure to social partners can modify unlearned preferences for the innards of objects. Further studies should clarify which role has movement of objects to determine preferences for hollow vs. filled objects.

PB-017

The need for affiliation as a driver of infants' social categorization

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People tend to categorize the social world into “us” and “them”, a tendency with dire consequences for intergroup relations. Recent studies show that this tendency may be present already in infancy. The present studies investigated why infants form social categories. Drawing from evolutionary psychology, we investigated the role of two basic motivations: Collaboration and Competition. Moreover, we further addressed the argument that these two motivations may not apply equally across genders.

Experiment 1 primed 14-month-olds' with either a Collaboration or a Competition video, followed by a racial categorization task. To test the gender hypothesis, half of the infants categorized women, and half categorized men. We found that when presented with women targets, infants categorized better in the Collaboration than in the Competition condition, whereas when presented with men targets, the pattern was reversed.

Experiment 2 examined the directionality of the motivational effects by exposing infants to a neutral prime. Comparisons of infants' performance in Experiments 1 and 2 revealed that Collaboration boosted infants' categorization of women relative to their baseline capacity, and Competition had a similar effect for the categorization of men. Finally, in Experiment 3, infants were exposed to the same two motivational primes, but these preceded an animal categorization task. Here we found no difference between the two conditions, indicating that the motivational primes were social specific.

Altogether, these results support an evolutionary account of social categorization, according to which basic and gendered motivations underlying group cognition motivate the formation of social categories.

PB-018

Children's intention-based moral judgments of helping agents

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During preschool years, children's disapprovals of harming actions and agents increasingly rely on intention rather than outcome. We studied whether a similar outcome-to-intent shift occurs in children's judgments of helping agents. Children aged four-to-eight ($N = 404$) were asked to evaluate the goodness and the deserved reward of attempted and accidental help. We found an outcome-to-intent shift in goodness but not in deserved reward evaluations. With age, attributions of goodness to the character that attempted to help increased, and attributions of goodness to the character that helped accidentally decreased, showing the emergence of an intent-based goodness moral evaluation.

Analyzing test questions order effects, we also found that with increasing age, goodness judgments constrained judgments of deserved reward, and vice versa. These findings challenge recent theoretical proposals concerning the conceptual change and cognitive architecture underlying the development of moral judgment. We suggest that our results are more consistent with the hypothesis that the outcome-to-intent shift reflects changes occurring outside the moral domain, such as in theory of mind or executive function, rather than a conceptual reorganization inside the moral domain.

PB-019

The Role of inter-group biases in children's acquisition of information about others' personality characteristics

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In social learning situations children tend to follow in-group informants [Kinzler, Corriveau, & Harris, 2011]. In two studies, we aimed to understand how children's initial social biases interact with this information gathering strategy. In particular we asked whether children have similar biases for the personality characteristics of in-group and out-group individuals and also whether the tendency to follow in-group informants can be used to modify initial biases that children might have regarding novel individuals.

Results of study 1 showed that 6-7 year-old ($N = 23$) children tend to endorse positive judgments as opposed to negative ones for novel individuals regardless of the group identity of the informants. However, this positivity bias decreased significantly in cases

where an in-group informant asserted a negative judgment for an outgroup target. Thus, although children do not readily attribute negative characteristics to out-group members, they tend to accept negative judgments for out-group individuals when these judgments come from in-group members.

In Study 2, we challenged 4-5 year-olds' ($N = 33$) initial in-group preferences. Preliminary findings suggest that when an in-group informant gives positive testimony for out-group targets, children prefer these targets as playmates (instead of in-group targets); however this change in preferences was not observed when the informant was an out-group member.

Thus, these results suggest that in social learning or social preference situations children's choices are not dictated by out-group aversion or in-group favoritism alone; instead, these two biases interact and children's initial tendencies can be modified according to the situation.

PB-020 **Give and keep: The effect of verbs on sharing in children**

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Language can play a subtle, but crucial role in important social behaviours such as sharing. In a typical study of sharing, children are asked to give some of their rewards to another individual (e.g., Brownell et al., 2009). However, the direction of the verb might influence sharing, with "give" placing emphasis on another individual and "take" leading to more self-regarding choices.

Children between 4 and 5 years of age engaged in various activities such as puzzle building with a puppet. To determine whether "giving" is interpreted as more other-regarding than "keeping", the children were asked to either "give some of" the stickers to a puppet or to "keep some of" the stickers for themselves when dividing rewards. As well, they were given "tidy-up" trials in which they were asked to put some (or all) of the play items into one of two containers using a neutral verb.

Younger children gave more stickers to the puppet when asked to "give some" than "keep some". This effect was weaker for the 5-year-olds. These results suggest that when asked to give, children are more generous than when asked to keep. Language has an important influence on prosociality in children. This study highlights the importance of verbal instructions on prosociality, and might lead to the conclusion that children are more prosocial than they would otherwise be in a nonlinguistic setting.

PB-021 **The effect of self-focus manipulations on sharing behaviour in five- and six-year-olds**

Sandra Weltzien, Bruce Hood

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Studies of sharing and altruism in children have traditionally focused on the behavioral outcome of a game or task, but typically ignored the cognitive processes or biases that might influence sharing decisions. The present study explored the relationship between self-focus and altruistic behaviour in 90 five- to six-year-olds. Children were presented with 10 colourful stickers and asked to choose six of them to keep. They then constructed a picture of themselves, their best friend or a neutral farm scene using a background template and a number of velcro-accessories. Appropriate use of pronouns was ensured to steer attention towards either the self or interdependence. Next, the children completed an anonymous Dictator Game. The results revealed that focusing children's attention on their self led to a marked reduction in sharing behaviour: children's willingness to share, as well as the total proportion of stickers shared, decreased following self-priming. The current findings offer an interesting insight into the developing relationship between self and altruism, and are the first to indicate that self-focus manipulations can induce nuanced changes in children's sharing decisions.

PB-022 **The development of the endowment effect: Are there differences between consumable and non-consumable possessions?**

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The tendency to value our own possessions over items of equivalent value is referred to as an endowment effect. This effect manifests as a reluctance to trade possessions for items of equivalent or greater value. The emergence of the endowment effect is thought to occur around the age of 5 years in humans although an evolutionary account promotes the idea that this bias is innate in many non-human primates. Recent work demonstrates that in non-human primates, endowment effects are limited to the domain of food, rather than non-

consumable artefacts and may be a product of poor inhibitory control. Here we investigate whether endowment effects for consumable items emerge earlier than non-consumable items in humans and whether this bias is inversely related to the development of inhibitory control. We tested 80 3-to-6 year olds in a trading paradigm. In each trial, children's preferences for three items were established (food or small toys) and the middle item was endowed. Children were then offered a series of trades (the least preferred item, an identical item, the most preferred item) to establish whether endowment had altered the value of their possession. Standard inhibitory control measures were also collected. Results show tentative evidence for endowment effects for objects in the youngest children however, endowment effects for food emerged later in development. These results are contrary to the nativist account of endowment effects and cannot be explained by reduced inhibitory control. The theoretical implications of these results for the development of ownership concepts will be discussed.

PB-023
Too late to tell: Changing reactions to social norm transgressions through middle childhood

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"Tattling" is the reporting to an authority figure of a norm transgression by a third party. Tattling decreases as children grow older and develop a distinction between serious transgressions, which warrant reporting, and minor transgressions, which do not. Later still, adolescents who tattle to authority figures may be disliked by peers. We investigated whether characters who tattled on a variety of norm transgressions would be viewed as less likeable as children grew older, and whether tattling would be seen as a viable response to these transgressions for participants themselves. Participants were 146 children aged 5-6 and 9-10 years, from Italian and English primary schools. We read children four stories, in each of which a norm transgression (accidental property damage / minor conventional violation / serious etiquette violation / serious verbal abuse) and response to the transgression (reporting / not reporting) took place. Older children judged tattlers on the accidental violation as significantly less likeable than did younger children. They also judged characters who failed to tattle on the serious etiquette violation as significantly more likeable, suggesting that the declining popularity of tattling is not limited to its use as a response to minor norm

transgressions. Tattling was the preferred response for older children to the two serious transgressions, but the preferred response for younger children to all four transgressions. Results are interpreted in light of the theoretical supposition that at age 5-6, most children do not have a fully explicit model of their own reputations.

PB-024
Young children's second-personal protest against a partner's defection in a collaborative task

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The ability to form joint intentions and engage in joint actions is a critical step toward becoming a cooperative human being. Between two and three years of age, children become increasingly skillful at coordinating and collaborating in joint actions (Warneken et al., 2006; Brownell, 1990; 2006). However, an important question remains whether children understand such joint activities as joint commitments (Gilbert, 1990). Previous research investigated young children's commitment in joint activities (Hamann et al., 2012) and their reactions to various norm violations (e.g. Rakoczy et al., 2008); however, no study so far has examined children's second-personal reactions to violations of joint commitment.

We presented dyads of 3.5-year-olds ($N = 144$) with a collaborative task and manipulated in three between-subject conditions why one of them (the partner) stopped cooperating with the subject. In the Selfish condition, the partner stopped cooperating for an individual reward; in two control conditions, the partner defected either because she acted unskilled (Incompetent condition) or because the apparatus broke (Accidental condition). We observed subject's reactions to the partner's defection measuring different types of protest (descriptive; personal; normative) and teaching.

Children protested more in the Selfish condition than in the control conditions. Additionally, they exhibited more normative protest in the Selfish condition and more teaching in the Incompetent condition.

Thus, it appears that 3-year-old children understand joint tasks as joint commitments and protest against a partner who defects selfishly and knowingly. This illustrates children's growing understanding of norms of cooperative co-existence and the obligations they entail.

PB-025

The influence of knowledge and intentions on prescriptive norm-transgressions

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From early on, children distinguish different norm transgressions such as moral and social-conventional norms on a number of dimensions such as their severity (e.g., Smetana et al., 2012). However, moral and social-conventional norms also differ in the degree to which they depend on the underlying mental states leading to an action. When evaluating moral norm transgressions, emotions and especially blame play a crucial role. As blame attributions are highly sensitive to, e.g., the actor's knowledge or intention to bring about the action, also the evaluation of moral norms is highly effected by the actor's mental states. In contrast, the focus concerning social-conventional norms originates in the wrongness of the action, while emotions such as blame play a minor role. Consequently, social-conventional norms are less dependent on mental states (e.g., Giffin & Lombrozo, 2015; Josephs et al., in press). The current project investigates this predicted influence on different kinds of norms. In a set of studies, we have been testing 5- and 7-year-olds' integration of intentionality and false belief information in their evaluation of norm-transgressors. Preliminary data from 36 5- and 20 7-year-olds suggest that while the 5-year-olds do not see knowledge as a mitigating factor in any kind of normative evaluation, they integrate intentionality information systematically dependent on the norm in question. 7-year-olds consider both mental states in their judgments, while giving them more attention in moral than in conventional norm situations. Our data suggests that children's norm-learning is thus interrelated with their social cognition in a highly sophisticated way.

PB-026

On the acquisition of metonymy

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While metonymy occurs widely in communication among adults (e.g., "The saxophone missed today's rehearsal"), little is known about how it is understood or used by children. To investigate this, we gave 47 English-speaking children (aged 2;9 – 5;9) and 27 adults one comprehension task and two production tasks. Comprehension

task: For each of nine stories, participants were shown a picture presenting two individuals, one with a salient property. In the metonymic condition, the experimenter referred to one of them using a metonym; in the literal condition, she referred to the property itself. The child had to choose between a picture of the metonymic referent, the literal referent, and a distractor, and to explain her choice. Production tasks: Participants were asked (i) to refer to an unfamiliar game just demonstrated to them, and (ii) to provide names for individuals with salient properties. We found a significant interaction between age and condition for comprehension, with five-year-olds more likely to choose literal than figurative interpretations of metonymic expressions than three-year-olds. At the same time, there was an increase in metonym production with age. Overall, our results show that three-year-olds both understand and produce metonyms to some extent. They appear to find it easier to produce metonyms than more elaborate referential descriptions in certain contexts, and metonymy may serve as a useful strategy in referring to entities that lack a conventional label. The older children's tendency to interpret metonyms literally reflects, we suggest, a growing metalinguistic ability, which leads them to over-emphasize literal meanings.

PB-027

Articulation, language and cognition in children with language impairment: Mutual influence of levels

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This report discusses the relationship between the characteristics of articulation dysfunction in children and ways of formation of the language system and cognition. The results are based on study of longitudinal corpora of 19 Russian preschoolers with SLI from age 24-48 months in continuation 2-3 years (diaries and audio records; results of annual testing).

There were found two variants of development. Children with primary somatosensory dysfunction show the inaccuracy of articulation, based on the failure of operations for precision selection. Similar disorders of precision selection were found in the functioning of the lexicon and in searching the grammatical markers of these children. SLI children with normal articulatory precision demonstrated difficulty of deployment the articulatory sequence and were inclined to perseverations. Difficulties of utterance deploying and perseveration of methods of grammatical marking are typical for such children. Longitudinal observations confirm matching the structural features of the articulation dysfunction and development of language and cognition.

The concept of mirror neurons (Rizzolatti) is used to substantiate this matching. Criteria of differentiation of learning style (Bates) compared with the concepts of cortical organization the process of utterances generation (Achutina, Bernstein, Luriya). It is shown on the basis of the concept of image schemas (Lakoff) that somatosensory failure causes difficulty categorizing, and kinetic dysfunction causes underdeveloped purposeful behavior. Model of development is built, which is based on the supposition about the formation of cognitive and linguistic categories and processes based on the experience of perception and action.

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PB-028

Longitudinal effects of second language exposure on first language and executive functioning in the preschool context

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The effects of learning a second language (L2) in immersion settings when the first language (L1) is not yet fully stable, has been investigated most often among children of disadvantaged populations where the results indicated negative consequences for L1 (Cummins, 2001). The present study, investigated the longitudinal effects of early exposure to L2 on executive functioning and L1 skills in children of higher SES. Thirty 4-year-olds attending two types of preschools participated in the study at time 1 (t1): L1 preschools ($N = 12$) with Turkish instruction with one hour of English per day and L2 preschools where children are exposed only to English throughout the day. Children were tested at t1 at age 4 and at time 2 (t2) a year later when they were 5 and had been exposed to L2 for 2.5 years. Both language and executive functioning tasks were administered at t1 and t2. Results of t1 assessments revealed that children attending L2 preschools had significantly higher L2 receptive and expressive skills ($p < .01$), and executive functions performance ($p < .05$) than children in L1 preschools. At t2, children in L2 preschools again showed higher performance in L2 than children in the L1 preschool while the latter group displayed higher performance ($p < .05$) than the former in L1 narrative competence. The present study showed that advantages of bilingualism such as cognitive flexibility, extends to early L2 acquirers where children live in L1 community. Implications of the findings for cognitive as well as L1 skills will be discussed.

PB-029

Executive function abilities in preschoolers with specific language impairment

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Children with specific language impairment (SLI) have language abilities significantly below age expectations in the absence of a clear etiology. Although cognitive impairment is an exclusionary criterion for an SLI diagnosis, evidence suggests that children with SLI demonstrate sub-clinical cognitive deficits, including in executive function. Previous research has compared children with SLI and typical language on executive function measures, but few have included comprehensive tests of multiple executive function components in both the verbal and non-verbal domains. In the current study we applied an integrative framework model of executive function to test abilities in English-speaking preschoolers with SLI and peers with typical language. Executive function abilities were assessed using a battery of verbal and non-verbal measures of sustained attention, working memory, inhibition, and shifting. The SLI group performed significantly worse than the typical language group across components and domains. Specifically, the groups differed on verbal and non-verbal sustained attention and working memory, verbal inhibition, and non-verbal shifting. We also considered the relationship between executive function components within each language group. Integrative framework models assume that executive function components are related, but separable. In our sample, as predicted by the model, executive function components were moderately correlated in both the typical and SLI groups. Based on these data, we found that children with SLI demonstrate domain-general executive function deficits, but their executive function system appears to be organized like that of children with typical language. These findings have interesting implications for the relationship between language and cognitive development.

PB-030

A likely story: The influence of fantastical discourse context on children's on-line sentence comprehension

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Two-year-olds can use verb constraints to anticipate upcoming linguistic input (Mani & Huettig, 2012). Both adults and 3-year-olds can also make predictions about language in real-time using more complex world knowledge of the relationship between particular actions and agents (Borovsky, Elman & Fernald, 2012; Borovsky, Sweeney, Elman & Fernald, 2014). However, no work has investigated children's real-time interpretation of a fictional discourse that is inconsistent with their knowledge of the world. In the present study, we ask whether children and adults can use incoming fictional information that contradicts both lexical and world knowledge to constrain predictions about upcoming language input. Children hear short stories displayed via an eyetracker, each about a fantastical entity: for instance, 'Wendy the witch doesn't have sandwiches for her lunch. She has keys for her lunch'. These are followed by critical sentences such as 'Wendy is eating up the key' while children look at images including a sandwich and a key. Early findings suggest that children have difficulty in using discourse information to anticipate a referent, drawing instead on stable semantic relationships. We also explore the relationship of predictive language processing in fantastical contexts with other mental functions. Firstly, anticipation of events consistent with a fantastical fictional world may require the suppression of stable semantic relationships; we might therefore expect it to disrupt performance via demands on inhibitory control. Secondly, individuals who possess strong, well-defined semantic representations, as measured by semantic fluency tasks, may find it more difficult to override locally coherent candidate referents.

PB-031

How does bilingualism take positive effects on executive functions in early childhood?

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Bilinguals show superior performance on the various dependent measures of cognitive ability. There is evidence that show a positive link between second language proficiency and enhanced cognitive skills. Bilinguals exhibit behavioral advantages on

tasks with high demands on executive functioning, particularly inhibitory control [e.g., visual-spatial skills, analogical reasoning, and classification tasks]. The purpose of the present study was to show distinction between monolingual and bilingual children in tasks involving cognitive skills, to find evidence of superior cognitive development in bilingual children at an early childhood education level and draw attention to the importance of bilingual education. We compared 70 children (bilingual Croatian-Hungarian and monolingual Hungarian speakers) using PEBL- Psychology Experiment Building Language system - from which the Simon task and the Wisconsin card sorting test were performed. The results show that bilingual children outperform monolingual participants in inhibitory control, selection, decision making and in task-switching skills. These findings demonstrate the importance of having access to bilingual education at an early age.

PB-032

Differential reliance on the causal core concept in the domain of physics and biology

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Dispositional theories of causality suggest that people intuitively associate causality with an antagonistic interaction between an agentive cause-object and a passive effect-object involving an asymmetric impact of forces [e.g., Mayrhofer & Waldmann, 2014; Talmy, 1988; White 2013; Wolff, 2007]. This intuitive notion of causality is thought to root in specific bodily experiences acquired in development, namely when applying bodily force to change something physically by direct contact. Currently, however, developmental studies are lacking within the dispositional framework. The present study examines the developmental origins of a dispositional stance in causal judgment. Particularly, it aims at comparing the adoption of an agent-patient relationship when judging phenomena in both physical and biological domain. We examined children of three age groups (5-6-years-old, 7-8-years-old, 11-12-years-old) with an unspeeded sentence verification task, assessing their judgments of a biological event and a physical event. Apart from the type of interaction (stitch resulting in a swelling/collision resulting in a bump) and the type of interacting entities (living/inert), the events were matched in all aspects. After watching the events, children heard a series of 14 sentence pairs, covering the central aspects of dispositional causality [e.g., assumption of asymmetric forces, agent-patient role distribution, antagonistic interaction, goal-directed production of effect]. The children judged the appropriateness of each

statement. Results indicate that children of all age groups indeed adopt a dispositional stance when judging causal interactions in both physical and biological domain. Moreover, we found that the tendency to adopt a dispositional stance appears to get more pronounced with increasing age.

PB-033
Continuous representations of action efficiency in infancy

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In reasoning about action, infants apply the principle of efficiency, recovering attention when agents pursue goals using curvilinear paths if a straight path was available (Csibra et al., 1999). What representations support these capacities? The present research explores the hypothesis that infants represent cost as a continuous function within a naive utility calculus (Jara-Ettinger et al., 2015) by testing 6-month-old infants' expectations for efficiency using action trajectories differing in curvature. In Study 1, we habituated infants to a rational agent, whose goal-directed actions were constrained by tall barriers, and then measured how long infants attended when the same agent navigated over a novel, low barrier efficiently or inefficiently. In Study 2, we asked whether infants recover attention to inefficient actions solely on the basis of low-level perceptual properties by repeating Study 1 but moving the barrier beyond the agent's goal, causing all actions to be unconstrained. In Study 3, we used the unconstrained habituation events from Study 2 and the constrained test events from Study 1 to test whether infants expect an irrational agent to act efficiently given a novel constraint. Across these studies, we demonstrate that 6-month-olds [1] analyze trajectories of goal-directed action differing in curvature on the basis of their efficiency, [2] expect minimally costly action given novel constraints, even for previously irrational agents, and [3] differentiate between these actions on the basis of efficiency, not low-level perceptual differences in height or motion. Our findings indicate that continuous cost representations support an early, robust expectation for rational action.

PB-034
Intuitive optics: What nonhuman great apes know about mirrors and shadows

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There is ongoing debate about the extent to which nonhuman animals extract structural information from their environment. To provide more empirical data to answer this question, we examined what type of information great apes (chimpanzees, bonobos, and orangutans) gain from optical effects such as shadows and mirror images. In an initial experiment, we investigated whether apes would use mirror images and shadows to locate hidden food. We found that all examined ape species used these cues to find the food. Follow-up experiments showed that apes did not confuse these optical effects with the food rewards and that they did not merely associate cues with food. First, apes made use of the mirror to estimate the distance of the hidden food from their own body. Depending on the distance, apes either pointed into the direction of the food (when the food was out of reach) or tried to access the hidden food directly (when it was within reach). Second, naïve chimpanzees used the shadow of the hidden food to locate it but they did not learn within the same number of trials to use a perceptually very similar rubber patch as indicator of the hidden food reward. Together, these findings suggest that apes interpret mirror images and shadows as causal effects of the food rewards. Adding to a growing body of research, the current results illustrate how great apes make use of causal relationships in their environment.

PB-035
Infants' perception of unusual actions: Is it rational?

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Previous research found that 14-month-old infants predominantly imitated an unusual and inefficient action (turning on a lamp with one's forehead) when the model's hands were free, i.e., other means were clearly available (Gergely, Bekkering,

& Király, 2002). Rational imitation accounts suggest that infants evaluate actions by the rationality principle, which states that people achieve goals with the most efficient means. Thus, infants form expectations on others' actions, influencing their imitative behavior. We conducted an event-related potential (ERP) study to investigate whether infants experience violation of expectation (VOE) when observing the head touch. Twelve- to 14-month-olds ($N = 13$, 6 girls, further data collection is ongoing) watched videos of models demonstrating that their hands were free. Subsequent test frames showed either a hand or head touch action outcome. We assumed that infants hold expectations on how a person touches an object leading to VOE in response to the unusual head touch. The Negative central (Nc) amplitude (350-650 ms) was enhanced on central channels (C3, Cz, C4) in the head touch condition ($M = -18.66 \mu V$, $SD = 10.47$) compared to the hand touch condition ($M = -14.38 \mu V$, $SD = 9.21$), $t(12) = -2.228$, $p = 0.046$, $d = 0.41$. Thus, infants discriminated head and hand outcomes with differences in the allocation of attentional resources. The increased Nc for the unexpected action may illustrate an orienting response reflecting mismatch detection. Implications of the findings regarding infants' action perception and selective imitation will be discussed and compared to adult data.

PB-036
Mission improbable: Children's possibility judgments of improbable and impossible events across domains

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Children can distinguish possible events from impossible events by the age of 3 or 4. Moreover, children have been shown first to achieve a rudimentary knowledge of physics, followed by psychology, and then biology. However, little research has examined if children judge improbable and impossible events to be possible at the same rate across different domains [i.e., biological, psychological, and physical]. In the current study, children between the ages of 4.5- and 7.5-years-old ($M = 6.02$, $SD = .78$) were asked whether improbable and impossible events in three domains could happen in real life ($N = 36$; 75% female).

A 2 (Event Type: improbable, impossible) X 3 (Domain: biological, psychological, physical) Repeated Measures ANOVA indicated children judged improbable events ($M = -.648$, $SD = .062$) as more possible than impossible events ($M = -.907$, $SD = .031$), $F(1, 35) = 17.236$, $p < .001$, partial eta-squared = .330. However, there was not an interaction between event type and domain, $F(2, 70) = 1.894$, $p = .158$, partial eta-

squared = .051. Planned contrast analyses coded children's judgments of biological events as the most possible [+1], followed by psychological events [0], and finally physical events as least possible [-1]. Results indicate children did not differentiate one domain as being more possible than the others for both improbable events ($t(35) = -.422$, $p = .676$, r -contrast = .071) and impossible events ($t(35) = .627$, $p = .535$, r -contrast = .105). These contrast results indicate children's mental representations of possibility develop similarly across domain.

PB-037
6-year-olds and 9-year-olds use of probabilistic and feedback information in decision making

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Learning from feedback is an important ability for increasing decision quality over the life span. However, feedback does not necessarily improve decision making, especially when it is normatively irrelevant because sufficient information about the decision problem is already provided by description. For children the mere presence of feedback may cause a distraction from relevant information and lead to maladaptive strategies, like changing a successful and appropriate strategy after receiving negative feedback from a choice. We examined 6-year-olds', 9-year-olds' and adults' decision making in a child-friendly information board paradigm, in which cues with different validities predict outcomes for two options. We varied the presence of feedback, expecting an increase of systematic use of probabilistic information in children, especially 6-year-olds, when no feedback is provided. In addition to choices participants' judgments allow to assess their awareness of cue-criterion relations. Contrary to expectations, children did not benefit from a feedback-free environment to adjust choice behavior more systematically to probabilistic information. Systematic use of probabilities in choices was absent in 6-year-olds and low in 9-year-olds. Only very few children systematically relied on feedback by implementing a win-stay-lose-shift strategy. Our findings suggest that irrespective of potentially interfering feedback systematic use of probabilistic information is absent in 6-year-olds and still emerging in 9-year-olds. However, 9-year-olds but not 6-year-olds judgments were based on probabilities, i.e. they inferred outcomes from cue-criterion relations. We conclude that deficits in using probabilities for decision making partly stem from a lack of understanding the usefulness of this information in 6-year-olds.

PB-038**Preschoolers' use of rational and heuristic strategies in their selective trust**

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Recent research has amply documented that even preschoolers learn selectively from others, preferring, for example, to learn from previously accurate over inaccurate models. It remains unclear, however, what the cognitive foundations of such selective learning are. In some studies, children show rational, trait-based inferences when choosing models for certain problems, whereas in other studies children's choices seem to rest upon less sophisticated, heuristic processes. To explain these divergent findings, the current study directly tested the possibility that children are in principle capable of selective learning based on rational inference, yet fall back on simpler heuristics due to tasks demands under some circumstances. Preschoolers ($N = 80$) were shown pairs of models that either differed in their degree of competence in one domain (strength or knowledge) or were both highly competent, but in different domains (e.g. strong vs. knowledgeable). In the test trials, children chose between the models for strength- or knowledge related tasks. The results suggest that, in fact, children are capable of rational inference-based selective trust: when both models were highly competent, children preferred the model with the competence most predictive and relevant for a given task. However, when choosing between two models that differed in competence on one dimension, children resorted to halo-style wide generalizations and preferred the more competent models for all kinds of tasks including irrelevant ones. These findings suggest that children might be rational, yet cognitively parsimonious, selective learners who make use of rational strategies only when simpler heuristic strategies fail to yield determinate answers.

PB-039**Getting the mouse out of the box: Preschoolers' convergent and divergent thinking and innovative tool manufacture**

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Children's tool use develops substantially during toddlerhood (McCarty et al., 2001; Pauen & Bechtel, accepted). However, little is known about tool innovation in early years. First studies point to a lack of innovation until school-age (e.g. Cutting et

al., 2014). The present study investigates 5-year-olds performance in an innovative tool-manufacturing task. Children are asked to manufacture a tool suitable to free a toy mouse from a transparent box. A second task requires them to use a different solution strategy to achieve the same goal. New materials are provided to manufacture a functional tool while old ones remain present. Differing from previous work, we not only code success rate, but also the number of solution attempts and the time needed to find the solution. Furthermore, we explore the relation between tool-innovation performance and convergent as well as divergent thinking, as assessed by standardized procedures.

Preliminary analyses based on $N = 10$ children suggest the existence of systematic relations between divergent as well as convergent thinking and innovative tool use. More specifically, divergent thinking is correlated negatively with number of solution attempts in task 1 ($r = -.54, p = .05$), but marginally positively in task 2 ($r = .46, p = .07$). Convergent thinking is positively correlated with performance in task 2 [success: $r = .70, p = .03$; time for finding the solution: $r = -.55, p = .05$], but not in task 1. Data collection is still underway and final results will be presented based on a sample of at least $N = 20$ children.

PB-040**Active participation versus observation learning of joint actions**

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Classical theories argue that children learn to perform tasks by initially participating in the task with an adult and subsequently mastering the task independently as a result of this scaffolding (Wood et al., 1976; Vygotsky, 1978). However, imitation theories focus on observational learning whereby perception-action links allow observers to simulate another's actions from mere observation (Rizzolati & Craighero, 2004). This study aims to compare children's learning of a bimanual piano-playing task from either a) actively taking part in the task with an adult (each participant performing half of the task unimanually) [Active condition]; b) observing two adults dividing the task between them in the same way (Joint Observation condition); or c) observing one adult performing the task bimanually (Bimanual Observation baseline). Data from 126 3-6 year-olds show that children were more likely to copy bimanually if they had been in one of the two observation conditions than in the Active condition (Joint Observation: $\chi^2 = .665, p = .01$; Bimanual Observation: $\chi^2 = .701, p = .008$), with no

difference between observing one or two actors ($\chi^2 = .04, p = .84$). This suggests that observational learning better allows children to form a global representation of multiple actions in a task than active participation, which is likely to evoke role-assignment which hinders global imitation. This is supported by the lack of a difference between the two observation conditions, suggesting an agent-neutral representation of the task. This has implications for children's representation and learning of joint actions.

PB-041

Young children act reasonably when making joint decisions with peers

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Providing explanations about information reliability is an advanced meta-argumentative skill, which has only been observed in the discussions of adolescents. This study investigated how younger children evaluate and provide explanations about information reliability while reaching joint decisions with peers. Pairs of 5- and 7-year-olds ($N = 196$) were presented with a novel animal with three unique characteristics (e.g., eating rocks). Each child within a pair learned about the animal individually by watching a different clip. In the unequal reliability condition, children received conflicting information about the animal (one child learned that it eats rocks; the other sand) from unequally reliable sources (one child heard a first-hand report; the other a second-hand report). In the equal reliability condition, children received conflicting information from equally reliable sources. In the same information condition, children received the same information from unequally reliable sources. Later, each pair jointly decided on the three things out of six that the animal needed (e.g., choose sand or rocks). Children in both age groups favored the items supported by the first-hand report in the unequal reliability condition (also in the same information condition); whereas they did not favor one set of items over the other in the equal reliability condition. Moreover, for both age groups, the two conditions with conflicting information elicited more explanations about information reliability than the same information condition. Overall 7-year-old pairs produced more meta-talk than 5-year-olds did. These results provide support for a view of children's joint-decision making is a context facilitating their reasoning and argumentative skills.

PB-042

The role of memory in children's perspective-taking ability in a referential communication task

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Successful communication draws upon people's ability to reliably take others' perspectives into account. Studies have shown that children and even adults frequently fail to take into account their communicative partner's perspectives. Perspective-taking can be decomposed into three sub-processes: computing, holding in mind and using perspective information; thus memory has long been assumed to be an essential factor, which limits perspective-taking performance. A recent study by Wang et al. revealed that surprisingly the relative size of common ground versus privileged ground in a standard communicative task had no systematic effect on 8 and 10 year-old children's ability to account for a communicative partner's perspective. However, the memory demand was minimized in this study, as the perspective information remained available and could be computed online. Thus, we adapted this communicative task to carry memory load, where participants were obligated to encode, store and retrieve their communicative partner's perspective information in order to successfully complete the task. Fifty-seven 10-year-olds and forty-one 8-year-olds were randomly assigned to either the standard version or memory version of the communicative task. The size of common ground was manipulated by varying the number of presented objects. Overall, 10-year-olds committed fewer egocentric errors than 8-year-olds. Eight-year-olds showed a growing egocentric tendency with the increase of the size of common ground, but only under the memory version. Interestingly, the size of common ground didn't exert any systematic effect on 10-year-olds' perspective-taking performance, regardless of task versions. These findings provide insightful understanding of the role of memory in children's perspective-taking.

PB-043

Age-related differences in consolidation of implicit sequential memories across human life span

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Recognizing sequential regularities of the environment underlies motor, cognitive and social skill acquisition, and is essential for predictive behavior and decision making in day-to-day activities. Therefore it is crucial to understand how sequence learning occurs and how the acquired information consolidates and stabilizes over time. Yet, the ontogenetic changes of these processes are still poorly understood. Here we aimed to characterize age-related differences in the consolidation of sequential memories between 7 and 85 years of age. Participants were clustered into nine age groups. The Alternating Serial Reaction Time (ASRT) task was used to measure implicit sequence learning. Participants were retested 24 hours after the learning phase. Two aspects of learning were analyzed, namely general skill and sequence-specific learning. We found greater variability both in general skill and sequence-specific knowledge after the 24-hr delay period in the younger age groups between 7 and 10 years of age. These results remained stable even after controlling for age-related differences in overall accuracy and reaction time. In sum, our findings highlight marked changes in the fronto-striatal circuits in childhood mediating sequential memory formation and consolidation, while these processes seem to be well-established from adolescence to late adulthood.

PB-044

Tracking frequency at birth: An fNIRS study investigating how neonates segment a continuous stream

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The general structure of language is universal; no language features the function head (filled by determiners, auxiliaries etc.) in the middle of a syntactic unit. Instead languages feature function words at the edge of the syntactic unit. If the relative

position of function words is constrained, humans may be biased to use them as a cue to parse continuous speech.

We tested this prediction with NIRS by using one distinctive feature of function words, their high frequency. Specifically, we asked whether infants prefer to use syllable frequency over a general mechanism to parse continuous speech: transitional probabilities.

Newborns were familiarized to continuous ...FiiFiiFiiFiiFii... stream (175s) built using 8 syllables among which one syllable was 8 times more frequent (F) than the others (i). Test block presented 8 words with either frequent first (Fii) or frequent middle (iFi).

If newborns possess a bias to encode function words at the edge, they should segment the stream with the structure Fii and show a novelty response (increase in HbO) to iFi. If frequency has no effect, they should segment based on TPs. Since the drop in the TPs appears between the two infrequent syllables, they should segment the iFi structure and show a novelty response for Fii.

Preliminary results ($N = 8$ (iFi) and 12 (Fii)) revealed differential activation. The left fronto-temporal channels ($p = 0.042$) showed a greater novelty response for the Fii than for iFi condition, indicating that neonates segmented the stream by using a statistical mechanism rather than the frequency cues.

PB-045

Cognitive limitations measured behaviourally and with neuroimaging

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Cognitive limitations are at the heart of developmental research. Such limitations impact cognitive functioning and development across domains. This work focuses on measurement of mental-attentional capacity using behavioural and neuroimaging techniques within a constructivist theoretical framework.

Mental-attention is used to activate task relevant schemes within working memory. This paper presents new paradigms of mental-attentional capacity constructed to be compatible with functional magnetic resonance imaging (fMRI). Data from 7-16-year-olds and young adults illustrate that the presence of interfering information improves assessment of mental-attentional capacity across development and content domains. Unlike behavioral research that allows numerous possibilities for task construction,

fMRI poses many restrictions to task design, due to practical and physical properties of the imaging technique. Neuroimaging findings with young adults show a linear increase in brain activity as a function of difficulty. fMRI signal-change in brain regions of interest show that posterior brain areas (e.g., precuneus and fusiform gyri) show a distinct pattern compared to anterior brain regions (e.g., cingulate gyrus and middle frontal cortex). Anterior brain areas show a gradual, increasing pattern of signal-change across task-demand levels up to and including 7. In contrast, posterior brain areas showed a sharp increase in signal-change between task-demand 4 and 5, followed by an asymptote. Results may be indexing a difference in the upper bound of activation permitted by the corresponding areas, beyond, which there would be an asymptote that might differ from prefrontal (i.e., operative) to posterior (i.e., figurative) processes.

PB-046
The role of inhibition in working memory assessment across development

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Working memory (WM) underlies higher cognitive skills related to academic achievement and intelligence. Although, data indicate that task-irrelevant features, which require inhibition, improve the assessment of working memory, the relation of inhibition to working memory tasks remains unclear across domains. We examined the development of visual-spatial and verbal working memory using tasks with high and low contextual interference. In addition, we investigated how inhibition is related to these WM constructs using advanced modeling techniques. Children aged 7-16 years and adults completed colour matching tasks (CMT), letter matching tasks (LMT) and a computerized version of the colour Stroop. Participants decided whether stimuli (e.g., colours for CMT and letters for LMT) were the same or different compared to previously presented stimuli. The task increased in difficulty and consisted of six levels; ranging from a simple identification up to very complex. Confirmatory factor analyses on accuracy verified that the six difficulty levels (per task) significantly loaded onto four intended latent constructs: verbal WM (high interference), verbal WM (low interference); visual-spatial WM (high interference), and visual-spatial WM (low interference). A

series of structural equation models (SEM) found age to be a significant predictor of all cognitive constructs. SEM results showed that inhibition was more strongly related to the development of visual-spatial ability than verbal WM. Influences of inhibition on WM assessment are discussed.

PB-047
White matter maturation in temporoparietal junction and its connection to prefrontal cortex supports the emergence of Theory of Mind in preschoolers

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Understanding what other people think and believe is a hallmark of human cognition and is referred to as Theory of Mind (ToM). In human development, a milestone in ToM is achieved around the age of 4 years when children start understanding that others can have false beliefs about the world. To date, however, it is unclear what determines this developmental breakthrough. In particular, the neural mechanisms supporting this crucial step are unknown. Here, we related this behavioral change from failing to passing false belief tests to the maturation of brain structure in 43 three- and four-year-old children. Conducting a tract-based spatial statistics (TBSS) analysis, we showed that the development of false belief understanding correlated with increased white matter maturation in the core adult ToM network, i.e. right temporoparietal junction (TPJ), medial temporal gyrus, precuneus and medial prefrontal cortex. Probabilistic tractography from seeds in these regions yielded a network connecting temporoparietal and prefrontal brain regions. Children's false belief performance correlated in particular with connectivity between the TPJ and the anterior inferior frontal gyrus (IFG) via the arcuate fascicle. These associations were independent of any co-occurring development of language or executive functions and differed from earlier-developing anticipatory looking false belief tasks. The present findings thus indicate that both, white matter maturation in brain regions that support belief processing in adults, as well as an increased connectivity of the dorsal pathway connecting the belief processing region TPJ to the IFG pave the way for the emergence of a mature ToM.

PB-048

Mood valence and task switching in 7-8 year olds

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Research is increasingly supporting the intuition that emotional states have important effects on cognitive processes. Fluctuations in incidental mood states are known to affect cognitive performance across a variety of tasks in adulthood and childhood. Cognitive flexibility, the capacity to switch adaptively between cognitive tasks or mindsets, appears to be enhanced by positive mood states and unaffected by negative mood states when measured by verbal fluency or categorisation tasks. However, limited research has examined the effects of mood on cognitive flexibility with more controlled measures, or in childhood. We examined the effects of incidental mood on cognitive flexibility in middle childhood using a computerised set-switching task. Children completed the Switching Inhibition and Flexibility Test (SwIFT) both before and after watching animated videos selected to induce either positive, neutral or negative mood states. Self-report scales were used to verify the effectiveness of the mood manipulations. Outcome measures include switching and mixing costs, as well as overall accuracy and reaction times, and preliminary results suggest no differences in set-switching performance between neutral and either negative or positive mood groups. This may imply that mood effects on cognitive flexibility differ between paradigms or over developmental time.

PB-049

Measuring executive function and inhibitory control in children aged 12 to 24 months: validity and performance data for two new object-based tasks

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Currently, there are very few tools available to assess executive function (EF) and inhibitory control in children younger than 24 months, and this, in turn, limits our understanding of the early development of these skills. One challenge is that it is not possible to verbally explain rules to infants to direct their goal-orientated actions. Even when verbal instruction is not required, the reasons for success or failure may be unclear: An infant who does not engage with a task may not be able to do it, or they

may not find it interesting, or the infant's goal may not be the one the researcher has in mind. We will discuss the issues with measuring EF in infancy and present new and adapted tasks for this purpose – The Spoon Task and Shape-Switch – along with results from a longitudinal study with 36 infants at 12, 18 and 24 months which has resulted in fully specified procedures, coding schemes and validity data. Evidence of convergent and predictive validity comes from the BRIEF-P parental report questionnaire and children's 24 month performance on a battery of inhibitory/effortful control tasks [Kochanska, Murray & Harlan, 2000]. Data will be presented about individual differences in infant performance and the applicability of each test at different ages. Because they use objects infants understand and readily engage with these tasks are highly motivating and have good ecological validity, in contrast to the more abstract symbolic understanding required in the Day-Night Task and similar tasks for older children.

PB-050

Task-switching in preschool children

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Being able to flexibly shift attention when appropriate is a fundamental skill in development. Children under the age of 5 years find this difficult, particularly in situations in which there is competition with past rules. The current experiment explored developmental changes in attentional control using a new multiple block task-switching (MBTS) paradigm. Participants [4-year-olds, 6-year-olds and adults] performed simple visual detection tasks on target categories (i.e. dog or car). The experiment was divided into two parts: pure blocks involving a single target category, and mixed blocks involving frequent switches between two different target categories. Mix-cost (i.e., reaction time [RT] cost on repeated trials in the mixed blocks, compared to the pure blocks), switch-cost (i.e., RT changes in mixed blocks during task switches), and response-repetition (RR; i.e., shorter RTs when a response is preceded by another response) effects were analysed.

Results from the MBTS showed differential developmental performances. There was a significant mix-cost, which was not modulated by age. In contrast, the switch-cost was modulated by age, as younger children showed greater switch cost than older children. The RR effect was observed in all blocks but an interaction with age was only found in the mix blocks (i.e., larger effect for younger participants). The smaller RR effect with age may suggest a better self-monitoring/ meta-cognition in the form of

RT-accuracy trade-off when the stimuli involved ambiguity. The study yielded results that differentiated different types of processing cost related to levels of processing: task-related associative strength, attentional control and meta-cognition.

PB-051

Can you make me a drawing? Graphic demonstration in social interaction helps 3-year-olds to produce representational drawings

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Pictorial competence is a mentalistic competence, communicative in nature. This study examines whether and how the presence of an adult as a receptive agent of children's drawings has an effect on the early production of pictorial symbols. To this end, we compared 3-year-old children's representational drawing production in four experimental conditions, three conditions with an adult as a receptive agent (Receiver) and one condition without a receiver (No Receiver). In the Receiver conditions (Linguistic Feedback, Graphic Demonstration and Pre-drawn Pictures) children were explicitly asked to draw five simple objects for an adult, who had to use children's pictures to find the objects; the conditions differed in the adult's feedback with non-representational drawings. After interacting with the adult, children were asked to draw a second set of the same drawings. The results show that 3-year-olds are able to produce representational drawings when they link into the communicative ways that others create and use pictures. Children adjusted the content of their pictures to the needs of the adult only after she had demonstrated how to create the drawings with the intent to communicate the identity of the objects (Graphic Demonstration). These results are discussed in terms of the complex relations between drawing, referent, artist and viewer.

PB-052

The early construction of spatial attention: Culture, space, and gesture in parent-child interactions

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American and Israeli toddler-caregiver dyads were presented with naturalistic tasks in which they must watch a short video or concoct a visual story together. American caregivers were more likely to use left-to-right spatial structuring than right-to-left, and this pattern was attenuated or reversed in the Israeli caregivers. This effect was exaggerated for commonly ordered stimuli such as numbers and letters, and similarly present whether the caregiver was seated across from, or next to, their child. In a follow-up content memory task, we did not find a relationship between the level of parental structuring and memory for the information, which indicates that the encoding and retrieval benefits from culturally congruent structuring observed in older children are still developing at this young age. A comparison group of adults interacting with another adult showed little modulation of spatial structuring, indicating that this phenomenon occurs more in a developmental context and is not solely a reflection of adults' structuring for themselves. These results offer certain intuitive aspects of caregiving behavior (e.g., gesture and spatial layout) as a potential route for developing spatial orientation biases in early childhood, before children have developed automatic reading and writing habits.

PB-053

Reward location affects asocial and social learning of a puzzle-box task

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Puzzle box tasks are commonly used to investigate social learning mechanisms and strategies in children and other primates. Specific manipulation of puzzle box design is rare but has revealed species differences in the copying of causally irrelevant actions. The current study investigated whether the location of a reward within a transparent puzzle influenced asocial and social learning of reward retrieval in two- to four-year-olds. A shiny token reward (d = 4 cm) was placed either Near (5 cm) or Far (25 cm) to two Reward Retrieval Methods (RRMs) located to the right of a puzzle box. Sixty children were given

no social information before their interaction. Children in the Near condition ($N = 30$) were significantly more likely to retrieve the reward than children in the Far condition (FET $p < .01$). A further 180 children first watched a model demonstrate one of the RRM ten times with the reward either Near or Far. Children that watched a demonstration were significantly more successful than those with no demonstration (FET $p < .001$). Those that watched a Near demonstration had near ceiling levels of demonstrated RRM imitation. Conversely many children in the Far condition showed an emulative approach of socially learning reward retrieval but not copying the precise method. Thus, a 10 cm shift in reward location, away from the focus of action, affected the social learning mechanism employed. The implications of this are discussed in relation to social learning mechanisms identified in previous puzzle box tasks used with humans and other primates.

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PB-054
The effects of technological and non-technological tools on children's creative and collaborative storytelling abilities

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Technological devices are suggested to support children's cognitive abilities (Manches, O'Mally & Benford, 2010; Kagohara et al., 2012), however a recent study revealed that there is no significant benefit of using a technological device compared to its non-technological equivalent (Allen, Hartley & Cain, 2015). Our study explored the effects of using different tools [i.e. a technological storytelling tool, a non-technological version of it and no tool] on 6 and 7-year-old children's ($N = 38$) creative storytelling abilities and collaboration skills. The task involved telling stories using cubes that had different pictures on each side and these were presented to children both as real cubes and on a tablet. Children also told stories without using a tool as a baseline. In two separate sessions each child told six stories in total; three on their own (child alone session), and three with another peer (dyad session). Results suggested that not using a tool resulted in longer stories that included more difficult words as well as higher readability levels (RL), but a lower percentage of unique words both for child alone and dyad sessions. In addition, no significant difference was found between using the cubes and the tablet for the child alone session, whereas RLs and percentages of difficult words differentiated for the dyad session. In terms of collaboration, different tools did not affect children's work sharing. These results suggest that while evaluating the effects of technological devices on children's cognitive abilities, their non-technological equivalents should also be taken into account.

PB-055
Persistence of intuitive strategies on arithmetic word problems, extension of the Situation Strategy First framework

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Even before instruction children can solve word problems involving small numbers by simulating the actions and situations described. Recent evidence suggests that children use these intuitive strategies even with higher numbers (Brissiaud & Sander, 2010), which put forward the Situation Strategy First (SSF) framework, positing that the initial representation of the problem activates a situation-based strategy, and it is only when this strategy is not efficient that an alternative representation is constructed. In this longitudinal study 13 Year 3 classes ($N = 307$, mean age = 7.01) participated in January and June 2015. Word problems were presented in two versions which had identical phrasing but involved different quantities, making the solution easy to simulate (SI) or requiring mental arithmetics in order to reach the solution (MA). The results revealed that at the beginning of the year success rates were higher on SI problems than on their MA counterparts. At the end of the year children's success rate increased on some MA-problems, but even more on SI-problems. Most importantly, the gap between the SI- and MA-problems was significantly higher at the end of the year. The generalization of the distinction between Si and MA problems confirms that the semantic effects cannot be attributed solely to the depicted situation, but are also influenced by the ease of mental simulation. The findings confirm that the semantic encoding of the problem influences students even after mastery of mathematical operations in elementary school: they persist in their use of intuitive strategies despite the fact the arithmetic strategies were taught.

PB-056**Early differentiation between drawing, writing and numerals during mother-infant picture book reading interaction**

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Children construct knowledge about external representations in interaction with adults who operate as mediators of their cognitive processes. Several studies have shown that 48-months-old children are able to distinguish between drawing, writing and numerals. The present study examines the process through which 30- and 48-months-olds differentiate these representations with their mothers in picture book reading interactions. Specifically, we analyze which representational system was the focus of attention, and which aspects of knowledge about representations, their formal properties and/or their referential function, were elaborated during the interaction. Twenty-six mothers read a book with either their 30-months-old children ($N = 13$) or their 48-months-old children ($N = 13$). The book was designed especially for this study, including in each page drawings of an animal, its written name and the respective numeral for the number of animals depicted (1 to 9). Results show that dyads of both age groups focused their attention on drawings more than on writing and numerals. However, 48-months-old children and their mothers made significantly more utterances about writing and numerals than the other group. In relation to drawing, dyads talked especially about its referential function, in relation with the identity and quantity of the animals. With regard to writing and numerals, they talked about their formal properties, naming the systems and their units. In spite of the simultaneous presentation of drawings, writing and numerals in the book, mothers did not established relations between the three systems.

PB-057**Male advantage in approximate arithmetic but female advantage in exact**Wei Wei^{1,2}, Chuansheng Chen³, Xinlin Zhou²¹ Department of Psychology and Behavioral Sciences, Zhejiang University, Hang Zhou, China² National Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China³ Department of Psychology and Social Behavior, University of California, Irvine, California, USA

Previous research has shown that females consistently outperform males in exact arithmetic, perhaps due to the former's advantage in language processing. Much less is known about gender difference in approximate arithmetic. Given that approximate arithmetic is highly associated with visuospatial processing and there is a male advantage in visuospatial processing, we hypothesized that males would perform better than females in approximate arithmetic. In two experiments (496 children in Experiment 1 and 554 college students in Experiment 2), we found that males showed better performance in approximate arithmetic whereas females showed better performance in exact arithmetic. Furthermore, gender differences in approximate and exact arithmetic were accounted for by gender differences in spatial ability and language ability, respectively.



POSTER
SESSION C

PC-001

Some pieces are missing: Scalar implicatures in children

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Until at least 4 years of age, children, unlike adults, interpret ‘some’ as compatible with ‘all’ (Katsos & Bishop, 2011; Noveck, 2001). The inability to draw the pragmatic inference leading to interpret ‘some’ as ‘not all’, could be taken to indicate a delay in pragmatic abilities, despite evidence of other early pragmatic skills. However, little is known about the development of these implicatures’ production, although children seem to fare better with it (Davies & Katsos, 2010).

To investigate this discrepancy, we conducted a corpus study on early production and perception on ‘some’ in British English. All children utterances containing ‘some’ were extracted from the dense corpora of five children aged 2 to 5 ($N = 5276$) and analysed alongside an equivalent portion of their caregivers utterances with ‘some’ ($N = 5430$). These were coded following structural and contextual categories allowing for judgements on implicature plausibility.

The findings indicate that children begin producing and interpreting implicatures in a pragmatic way during their third year of life, shortly after they first produce the word ‘some’. Their production of ‘some’ implicatures is low but matches their parent’s input in frequency (and is similarly to that found by Degen, 2015 for adults). Additionally, the mothers’ implicature production increases as a function of the children’s age. The data suggest that as soon as they acquire ‘some’ children are fully competent in its production and mirror adult production. Nonetheless, ‘some’ is multifaceted, thus implicatures are infrequent, and structurally and contextually constrained in both populations.

PC-002

The early ontogeny of humans’ trust in communication

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Do humans start their lives as trusting creatures that become increasingly skeptical with time (Reid, 1764) or is there a developmental stage during which trust in communication increases (Hume, 1748)? To address this two-centuries-old question, we assess infants’ trust using a hiding game in which infants and toddlers have to find

a toy hidden under one of two buckets. In the crucial test condition, participants first see where the toy is hidden, and later an informant points to communicate to them that the toy is in the other bucket.

In Study 1, we find that 15- and 24-month-old infants are more likely to follow pointing than to trust their past perception ($p < .001$, One Sample Wilcoxon Signed Rank Tests), even when the informant has a false belief about the location of the toy. Moreover, we observe that trust in communication increases with age ($p = .001$, Mann-Whitney U test). In subsequent studies, we establish that infants’ disposition to follow pointing is genuine trust in communication, i.e. a disposition to treat communicated information as reliable. We find that infants’ trust cannot be reduced to mere desire to comply with the experimenter (Study 2), or to an imperative interpretation of pointing (Study 3).

These results suggest that human infants have a strong disposition to treat communicated information as a reliable source of information. Perhaps surprisingly, humans’ trust in communication develops further during toddlerhood. Increased communicative and linguistic abilities could support toddlers’ heightened trust in communicated information.

PC-003

Investigating infants’ use of a physical marker to find a hidden object and the influence of the informants’ knowledge state

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Although infants understand what another person can or cannot see (e.g., Brooks & Meltzoff 2002), little is known about whether they are able to use this understanding to make inferences about other people’s knowledge and their resulting trustworthiness. We presented 14- and 19-month-olds with two different informants, one who observed in which of two boxes an object was hidden and another one who did not (although being physically present). In warm-up trials, an experimenter introduced the hiding game by putting an object into one box (visibly for participants in warm-up 1, out of participants’ view in warm-up 2) and indicated the hiding location by pointing at the box and placing a marker (i.e., a wooden block) on it. Participants could then choose one box. In test trials, two informants (green vs. yellow), one who had witnessed the hiding and one who had not, both indicated different boxes to participants by pointing and placing a physical marker (i.e., a green or a yellow wooden block). Then, again,

participants could choose a box. Whereas participants at both age groups chose correctly in warm-up trials in which they observed the hiding (14-month-olds: 75% of trials correct, Wilcoxon test, $N = 40$, $p \leq .001$; 19-month-olds: 77% of trials correct, $N = 44$, $p \leq .001$), only 19-month-olds did so when they could not observe the hiding (66% of trials correct, $p \leq .001$). However, even the older participants did not use the informants' knowledge state in the test trials. These results are surprising given infants' success in false-belief tests.

PC-004
Two-year-olds follow adults' pointing gestures more than peers': Exploring communicative skills through peer interactions

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Though most toddlers spend an extensive amount of time in the presence of peers and siblings, the encounters they have with age-mates are qualitatively different from the structured interactions they have with caretakers. Such differences are likely to influence how children engage in either context subsequently. By contrasting infants' and toddlers' behavior with adults and age-mates under controlled experimental conditions, we can gain insights into the ways in which children themselves contribute to adult-child interactions in terms of specific motivations and expectations.

We tested 27-month-olds in a cooperative object-choice task in which partners took turns helping each other to locate a hidden toy by pointing out its hiding place. Under matched conditions, children were either tested in interaction with an age-mate or an adult experimenter. We found that children were significantly less likely to comply with cues offered by a peer than by an adult. In order to investigate whether children perceive or value information differently when it is provided by peers, we designed a follow-up study in which children were invited to play the same hide-and-seek game with a televised peer or adult in a semi-interactive set-up. This allows for the employment of looking time measures and the minute control of children's experience in the test. We found that under idealized conditions, as a group, children were still at chance with a peer partner but significantly above chance when following an adult's pointing gesture.

PC-005
What or where? The meaning of referential human pointing for dogs

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Dogs have a unique capacity to follow human pointing, and thus it is often assumed that they can comprehend the referential meaning of such signals. However, it is still unclear whether dogs perceive human directional gestures as signals referring to a target object (indicating what to manipulate) or a spatial cue (indicating where to do something). In the present study, we investigated which of these alternative interpretations may explain dogs' responses to human pointing gestures in ostensive communicative and nonostensive cuing contexts. To test whether dogs select the cued object or the cued location, subjects were presented with 2 alternative object-choice trials. An experimenter first attracted the attention of the dog either by calling the dog's name and looking at it (ostensive condition, $N = 24$) or by clapping the hands (nonostensive condition, $N = 24$) then pointed at 1 of 2 different toy objects. Subsequently, the experimenter switched the location of the 2 target objects in full view of the dogs by grasping the objects and making a 180° turn. Dogs were then allowed to choose between the 2 objects. In the ostensive condition, dogs showed a significant bias toward the cued location compared with the nonostensive condition in which they performed at chance. These results suggest that pointing refers to a direction or location for dogs, but only if they are addressed with ostensive cues that indicate the communicative intention of the signaler.

PC-006
Sharing innovations: Young children spontaneously teach naïve others how to make tools

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We explored the development of the teaching of tool-making innovations. Children learnt how to solve an innovation task (Beck et al., 2011) by observing Experimenter 1 (E1). E1 left and a second, naïve experimenter (E2) took a turn at the game. E2 used a

straight pipe cleaner to make repeated contact with the bucket (failing to retrieve it). Subsequently she requested assistance by eye contact followed by a verbal request.

In Study 1, we tested 42 children (25 boys) aged 2-9 years. Children saw a demonstration of hook making from E1. The majority of 3- to 6-year-olds 'taught' the experimenter how to solve the task: waiting for her to make an inappropriate attempt and then offering useful information. Older children tended to wait until the Experimenter interacted with them before offering advice.

3-6 year olds behaved as if they were spontaneously teaching E2 how to solve the task. However, we speculated that we had primed them to teach by explicitly teaching them the task solution.

In Study 2, children 'oversaw' E1 solve the task. We tested 26 children (11 boys) focusing on ages 3-6. Once again evidence for spontaneous teaching was found. However, examples of children giving 'advice' before the task had begun or failing to engage were seen especially in the younger group.

The observation that spontaneous teaching can be seen in 3-6 year olds, is important for our understanding of the natural pedagogy that might be unique to humans (Csibra & Gergely, 2009).

PC-007

The effect of 14-month-olds' familiarity with the informant in a hiding game

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When infants lack information about how to evaluate a situation, they look for and use information provided by others already at around their first birthday. When given the possibility to select between a familiar and an unfamiliar informant, infants show a preference for the unfamiliar informant in social referencing studies (e.g., Stenberg & Hagekull 2007). Whereas previous studies presented infants with an ambiguous object, we investigated whether infants would also prefer unfamiliar informants in their information search and use in a hiding game ($N = 100$). The advantage of this paradigm is that participants clearly lack information they need to solve the task. In warm-up trials, an experimenter hid an object in one of two boxes (visible to the infant in warm-up 1, invisible in warm-up 2) and then indicated the object's location by pointing at the target box. The infant then was allowed to choose one box (results: warm-up 1: 78% of trials correct, Wilcoxon test, $p < .001$; warm-up 2: 72% of trials correct, $p < .001$). In test trials, a familiar (i.e., the parent) and an unfamiliar (i.e., an assistant) informant both

observed the hiding. When infants looked for information they preferred to look first (56% of trials, Wilcoxon test, $p < .005$) and longer (19% vs. 13% of time, Wilcoxon test, $p = .001$) at the unfamiliar informant. However, after both informants gave different suggestions about the location of the hidden object by pointing at a box, infants did not distinguish between informants. This result challenges the universality of infants' preference for unfamiliar informants.

PC-008

Communicative reference to familiar objects induces kind-based individuation in 9-month-old infants

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Representation of objects in terms of object kinds facilitates object individuation in infants. Twelve-month-olds infer the presence of two objects behind an occluder if, and only if, the objects, which emerge from behind the occluder one-by-one belong to familiar and different kinds (Xu and Carey, 1996; Xu, Carey, & Quint, 2004). Younger infants need further evidence of kind membership provided by labeling (Xu, 2002) or demonstration of function (Futo et al., 2010) for object individuation in similar paradigms. We investigated whether ostensive reference is sufficient to induce a kind-based representation and individuation of familiar objects. In an individuation paradigm, we found that 9-month-old infants expected two objects behind an occluder when these objects were of familiar and different kinds and were ostensively referenced before they disappeared behind the occluder (Study 1). However, ostensive reference to the objects did not aid individuation when the objects belonged to the same kind but differed in visual features (Study 2). Our findings confirmed our hypothesis that ostensive referential communication can trigger kind-based object representation, as long as the objects are recognized by infants.

PC-009**Infant imitation of goal-directed actions: Effects of goal salience and of verbal cues**

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During the second year of life, the presence of salient action goals influences infants' imitation of goal-directed actions (e.g., Carpenter et al., 2005), and also do social-communicative cues of the model (e.g., Gergely & Csibra, 2005; Southgate et al., 2009). Here, we combined both factors to compare their relative impact on infants' selective imitation. Following Carpenter et al. (2005), 16-month-olds ($N = 38$; $M = 16.8$ months) observed two action-styles (hopping/sliding) of a toy mouse that either approached one of two houses (salient action goal) or stopped at the same end-positions (left/right) with houses absent. During demonstration, the model verbalized either the action-style or end-position (cf. Elsner & Pfeifer, 2012). As expected for goal salience, infants reproduced the action-style more exactly in the no-house than in the house condition (60% vs. 20% correct; $p < .01$), but showed the reverse pattern when reproducing the end-position (8% vs. 60%; $p < .001$). However, unexpectedly, the different verbal cues did not influence infants' imitation of the action-style ($p = .67$) or end-position ($p = .77$). These findings confirm that, depending on goal salience, infants render either the movement or the goal as more important for their imitation (and probably cognitive representation) of an observed action (Carpenter et al., 2005). Why, contrary to Southgate et al. (2009), verbal cues did not influence 16-month-olds' imitation, has to be discussed. Potential reasons include less developed verbal or social skills, as well as differences in study design. However, the findings confirm the relevance of context conditions for infants' interpretation and reproduction of others' behavior.

PC-010**Selective overimitation: The influence of pedagogical cues and uncertainty in copying by 4- to 7-year-old children**Emily R. R. Burdett¹, Nicola McGuigan^{1,2}, Rachel Harrison¹, Andrew Whiten¹¹ University of St Andrews, UK² Heriot-Watt University, UK

One of the explanations for "overimitation" in children is that they assume an adult is intentionally demonstrating the right way to do something, regardless of whether the actions appear irrelevant. Their copying thus appears indiscriminate. However, other

research has shown that children can be selective when learning. Here we explore the interplay between task opacity and children's understanding of interpersonal information transfer. We tested whether 4- to 7-year-olds will imitate irrelevant actions when they have the opportunity to learn from a model they witness being taught the way to open a puzzle box versus a non-taught model who demonstrates a different and more efficient method. We also explore whether children are more likely to choose the social learning option when a puzzle box is opaque than when it is transparent.

Children across all ages tested copied the most efficient method when presented with a transparent box regardless of whether a taught or non-taught model demonstrated an alternative inefficient action. However, 6-to-7-year-olds copied the irrelevant actions demonstrated by the taught model when the box was opaque, whereas 4- to 5-year-olds were at chance. When faced with a task opaque to them, older but not the younger children pay attention to pedagogical cues and track knowledge acquisition sufficiently strongly to overimitate irrelevant actions made by a taught model. When the task is clear, younger and older children disregard the social learning option and rely on their own causal understanding.

PC-011**Do 18- and 36-month-old infants update attributed beliefs by re-evaluating past events?**Ildikó Király¹, Kata Oláh¹, Ágnes Kovács², Gergely Csibra²¹ Eötvös Loránd University, Budapest, Hungary² Central European University, Budapest, Hungary

An emerging question in Theory of Mind research is when attributed beliefs are computed. Taking as example the standard location-change false-belief task, belief attribution could take place (i) when Sally puts her chocolate into box A, or (ii) when the location change takes place. The first option requires sustaining alternative representations of the environment, while the second one requires maintaining representation of past events that might have generated beliefs in others.

We tested 18- and 36-month-olds in a modified location-change task (Southgate et al., 2010). Children were first presented with model, who was present during a location-change event wearing sunglasses. After the model had left, children were allowed to explore her sunglasses, which were either opaque (FB condition) or not (TB condition). If children update the belief content of the model on the basis of this information, they should give the model the requested object in the TB condition and the other one in the FB condition. Our results revealed that while 18-month-olds ($N = 24$) tended to

choose always the requested box, 36-month-olds ($N = 36$) chose more often the non-requested box in the FB condition than in the TB condition [Fisher's exact test: $p = 0.0016$]. These results suggest that while 18-month-olds computed the belief of the model on-line 36-month-olds were able to update the attributed belief based on their memory of an earlier event.

PC-012
**Searching for the exact time of belief reasoning:
 An EEG study of adults' spontaneous belief tracking**

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Recent research demonstrated that adults automatically encode others' beliefs [Kovács et al., 2010; Van der Wel et al., 2014]. However it is unclear, when exactly participants engage in false-belief reasoning in a typical theory-of-mind scenario. Do they process others' beliefs when i) the reality changes without the knowledge of the protagonist or when ii) the protagonist returns to the scene? We investigated this by measuring neural correlates of processing others' beliefs using EEG. Specifically, we used an implicit avoidance-false-belief task. Participants observed as an angry dog passed by one box, entered another one and finally jumped into a third box. Their task was to put a cat into one of these boxes while avoiding the dog. In addition a protagonist was also present, who was irrelevant to the task. In the false-belief condition [FB] she turned away and thus had a false belief about the dog's current location, whereas in the true-belief [TB] she knew about the dog's location. We analyzed induced alpha-range oscillatory activity in 10 electrodes over medial parietal cortices. Results ($N = 15$) showed a significant increase in alpha synchrony in the FB compared to the TB condition when the protagonist returned [ii] [$t = 14.00, p = .009$], but not when reality changed [i] [$t = 45.00, p = .394$]. Relying on the claim that alpha synchrony signals inhibition of task-irrelevant information [Roux & Uhlhaas, 2013], our data suggests that participants likely spontaneously reactivated and inhibited the protagonist's false belief before giving an answer in which the other's belief was completely irrelevant.

PC-013
Tracking multiple minds: Working memory (WM) and executive function (EF) in preschool theory of mind.

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Theory of mind development occurs in small groups (e.g., a family) where a number of agents may have differing mental states. False belief [FB] studies, however, have required a child to track only a single agent's FB. We document the limit on preschoolers' WM for multiple agents' FB's at two levels of executive demand in several studies. In low-demand tasks, we find that three-year-olds perform well tracking single-, double-, and even triple-agents with distinct false beliefs, but their performance drops off with four agents. In contrast, four-year-olds continue to do well even with four agents. With high-demand, three-year-olds fail even a single-agent false belief task, but performance does not suffer further with increasing agents, instead it only produces a rise only in FB binding errors (binding a FB to the incorrect agent); four-year-olds pass single-, double-, and triple-agent tasks, but performance suffers with four agents. Preschoolers have ample WM to track small groups of individuals: about three at age three and four at age four; executive demands are far more limiting.

PC-014
Cross cultural differences and similarities in metacognition and theory of mind

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An increasing number of studies investigated cross-cultural differences concerning children's theory of mind understanding. Using false belief tasks some studies point to universality of theory of mind whereas others document cultural variation. Theoretically, metacognition – broadly defined as thinking about thinking – encompasses theory of mind understanding [Chandler & Carpendale, 1998; Flavell, 2000; Kuhn, 2000]. Nevertheless, metacognition and theory of mind have been investigated independently of one another and only a few studies investigated the

relationship between the two areas [Lecce et al., 2014; Lockl & Schneider, 2007]. Moreover, cultural variation – or its absence – in metacognition is largely unknown.

In the present research, we asked whether 4-year-old Japanese and German children differ in metacognition, specifically an understanding of one's own varying knowledge states, in comparison to their theory of mind. The same children received a metacognition task [Rohwer et al., 2012] in which children were asked to verbally indicate whether they do or do not know the hidden contents of a container as well as a standard, change-of-location, false belief task.

We found cultural variation in theory of mind but not in metacognition. Children from both cultures tended to overestimate their own knowledge states in the explicit verbal responses. By contrast, Japanese children's false belief understanding lagged behind that of German children. The findings may suggest different developing processes for theory of mind and metacognition.

PC-015 **Is true belief a problem for 4- to 6-year olds?**

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False belief tasks have usually been the method of choice in the investigation of Theory of Mind (ToM) competences in children's belief ascription. It has commonly been assumed that children hold a full blown ToM competence as soon as they can solve classical false belief tasks around age 4. However Fabricius et al. [2010] show that 4 to 6 year old children are not able to attribute true beliefs in location change or unexpected content tasks. They suggest that 4-to-6-year old children are located in a transitional period from reality reasoning to belief reasoning where they think about beliefs using perceptual access reasoning (PAR), which produces right answers in false belief but wrong answers in true belief tasks. It has also been shown that these children fail in true belief aspectuality tasks, which is explained by the metal file card theory (MFCT) [Perner et al., in press]. We recommend an alternative explanation: True belief tasks may be confusing due to the lack of sense of the testing question. We designed location change and aspectuality tasks which measure true and false belief within the same trial by using two protagonists holding different beliefs. Preliminary data show that 4- and 6-year olds ($N = 58$) perform above chance in false and true belief versions of location change and aspectuality tasks. More critically, performance in false and true belief versions of the tasks are highly correlated [correlations $> r = .69$]. The improvement of performance by our manipulation can be explained neither by PAR nor by MFCT.

PC-016 **Evidence for spontaneous level-2 perspective taking in children and adults**

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Social interactions are fostered by humans' propensity to compute their partner's perspective spontaneously. Carruthers [2015] proposed that, due to the mindreading system's limited capacity, spontaneous level-1 perspective taking (PT) can only occur for those objects that the partner is attending, judged by his gaze direction. We hypothesize that, for the representationally more complex level-2 PT to emerge spontaneously more specific cues are needed, as looking at an object does not necessarily imply processing all of its features, including the aspectual ones. We propose that if participants are provided with information that the other attends to the object's aspectual property, level-2 PT emerges spontaneously. In study 1, pairs of adult participants performed the number verification paradigm of Surtees and colleagues [2012], viewing stimuli from opposite directions. In the same task group, both participants had to focus on the perspective dependent stimulus feature (numerosity), while in the different tasks group the partner attended to a non-aspectual stimulus feature (color). When the partner's task called for processing aspectual properties, his inconsistent perspective interfered with RT-s, despite that participants were never asked to take the other's perspective. Reaction times were not affected when the other's task did not involve processing perspective dependent features. The preliminary results of Study 2 indicate that under the same conditions, spontaneous level-2 PT is also present in 9-year-old children. The findings suggest that level-2 perspectives can be computed quickly and spontaneously. However, more specific cues are required on the other's focus of attention than the direction of his gaze.

PC-017

Young children, but not chimpanzees, are averse to both disadvantageous and advantageous inequities

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An important fairness related construct is inequity aversion, i.e. the tendency to dislike and correct unequal outcomes. Research so far revealed an early developing strong social component of inequity aversion in humans [e.g. McAuliffe, 2014], suggesting its function to regulate cooperative interactions [e.g., Fehr, 1999; Brosnan, 2011].

Accordingly, inequity aversion should not be present, and also should not be restricted to social situations, in species that do not dispose of an evolutionary history of cooperation and obligate mutualism, such as nonhuman primates [e.g., Tomasello, 2009].

To test this hypothesis we compared the reaction of human children (2 to 4 years) and chimpanzees (Pan troglodytes) towards different distributive food offers in a social and a nonsocial scenario, applying a highly similar study design. The offers were either equal or unequal, and either of high or low value. We coded whether subjects showed any aversive reactions like rejecting the food, sharing or requesting behavior.

Results show that 3- and 4-year-olds ($N = 64$) show high rates of aversion for unequal offers, but only in the social condition. This pattern was also observable in 2-year-old children ($N = 18$), although limited to girls. As expected, chimpanzees ($N = 9$) did not differ in their behavior between social and nonsocial situations, and almost exclusively displayed aversive behavior towards unfavorable offers. These results suggest a very early developing sensitivity towards fairness in humans, but not in non-human primates. Its strong social component supports an evolutionary explanation about how and why inequity aversion could have evolved.

PC-018

Children's pro-social behavior when actual group membership conflicts with personal preferences for group affiliation

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Within distributive contexts, it is rare to find out-group-favoritism or in-group-negativity. Here, we addressed this theoretical possibility by disentangling recipients' actual group-membership from their group affiliation preferences.

169 4-year-olds played a forced-choice distributive task, in which a 'fair' option [1 'good' resource for themselves, 1 'good' resource for recipients] and a 'spiteful' option [1 'good' resource for themselves, 1 'bad' resource for recipients] were available. Two consecutive rounds were played with unfamiliar recipients, and three variables were tested: [1] recipients' 'Group-membership'- color-based in- or out-group [within-participants], [2] recipients' 'Personal preferences'- recipients either stated a preference to join a particular group [followed by assignment to that group], or stated indifference to join either group [followed by random assignment] [between-participants], [3] strength of participants' own 'Group-identification'- determined by questioning participants which group is 'the best' [high-Idnt or low-Idnt].

GLMM analysis revealed an interaction between the three variables. Namely, towards in-group recipients, low- and high-Idnt participants favored the 'fair' option, but only towards recipients who preferred to join their in-group. However, towards out-group recipients, low-Idnt participants acted 'fairly' towards recipients who preferred to join the out-group, whereas high-Idnt participants acted 'fairly' towards out-group recipients who were indifferent to join any specific group. Exploratory analyses revealed additional gender differentiation.

The findings highlight a possible premise underlying children's group-bias, which is that mere group-membership might be taken as indicative for group-members' affiliative preferences. The balance given to individual- and group-related considerations [e.g., personal preferences vs. actual group-membership] is discussed within moral and societal frameworks.

PC-019

Why should you help me? Investigating 5-year-olds' selective trust in potential deceivers

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The present study investigated 5-year-old kindergartners' spontaneous selective trust in informants depending on self-interest inferences. Children were randomly divided into two groups, playing an object finding task with a co-player whose self-interest was either congruent or conflicting with those of the participant. Children were more likely to mistrust spontaneous and unpredictable hints given by the co-player when their interests were conflicting. However, only a small proportion of children mistrusted such information right at the start. After being misled once, children in both conditions

were able to mistrust subsequent advice provided by the hitherto inaccurate informant. When asking children verbally about the situation, they interpreted misleading advice depending on self-interest of the co-player as either deceptive or ambiguous. Results are discussed regarding methodological issues in previous studies on selective trust as well as the ontogeny and implications of selective trust in young children.

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PC-020
Infants individuate agents in dyadic social relations through the principle of relational consistency

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Recent findings suggest that infants interpret giving and taking as cues to different social relations regulated onto qualitatively distinct relational models (equality matching and communal sharing; Tatone & Csibra, 2013). If so, infants should expect two agents not to engage in both types of transferring actions between each other, as this would indicate mutually incompatible social relations. Across two looking-time studies, we tested whether 12-month-olds apply such “principle of relational consistency” (PRC) to determine 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 then going back behind the occluder. At test, infants saw a new agent interacting twice with a new patient, once by giving and once by taking, as in the familiarization. At the end of the second action, the occluder was removed to reveal one or two (identical) agents. If infants apply the PRC, they should infer two agents behind the occluder (a Giver and a Taker), instead of a single one (Giver/Taker), as this would imply representing a single dyadic relation based on mutually incompatible relational models. As predicted, infants looked reliably longer at the one-agent outcome, suggesting that, despite the identical looks of the Giver and the Taker, they thought that two different agents performed these actions.

PC-021
Infants expect helpers to carry out fair distributions of resources

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We investigated whether infants link two core aspects of the moral domain: personal harm and fairness in distributions. Forty-eight 15-months old infants participated. Sixteen infants were assigned to one of three conditions. Each condition consisted of a familiarization phase followed by one test event. In the helper condition, infants first saw an agent helping another agent to reach the top of a hill. In the hinderer condition infants saw an agent sabotaging the climber's attempts to reach the top of the hill. In the control condition no helping or hindering actions occurred, instead the 'hinderer/helper' of the previous conditions was replaced by an agent that moved a cup to the top of a hill. In the test phase, half of the infants saw the helper/hinderer/mover carrying out an equal distribution among two identical recipients, whereas the other half of the infants saw him performing an unequal distribution by giving all goods to one of the two recipients. Infants in the helper condition looked significantly longer at the unequal distribution test event, whereas infants in the other two conditions looked equally long to the two test events. Infants generated a fairness expectation after looking at helping actions, but did not generate any expectations after looking at a neutral or hindering action. Overall, these results provide the first evidence that infants can link helping actions to agents' fairness in distributive actions and give further support for current proposals on an early emerging ability to generate socio-moral evaluations of agents and actions.

PC-022

Are leadership's roles understood in 15- and 18-month-old infants?

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Little is known about human infants' recognition of some forms of social influence such as leadership, the disposition of an individual to lead a group (the leader) and of others to imitate the first one (the followers). In our work we explored the infants' expectations about the stability of the different leadership roles across situations.

Using an eye-tracker, we recorded 15- and 18-month-olds' eye gaze behaviour while watching short animations depicting the action of four agents (similar to Powell & Spelke, 2013).

During familiarization, two of these agents performed different actions. Later, the other two agents (the followers) consistently copied the action performed by one of the agents (the leader), but not the action performed by the other agent (the non-leader). These events were repeated four times, counterbalancing the movements and the positions of the agents, but maintaining their roles.

During test, we measured infants' expectations about a novel situation, in which agents followed or not the path of another agent. In the incoherent test, a "follower" failed to follow the "leader." In the coherent test, the "leader" chose not to follow a "follower." At the end of the test, infants' looking time at the screen was measured. We hypothesized that if infants infer stable leadership relationships during the familiarization events, they should look longer at incoherent than at coherent tests.

The preliminary analyses indicate that 18-month-olds tend to recognize leaders and followers, and expect that their relationships generalize across situations.

PC-023

Why do some children judge deviations from the norm as morally wrong? The role of explanation in children's socio-moral judgments

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Children's evaluations of harm-based transgressions tend to differ from their evaluations of social-conventional transgressions (Smetana, 2006). However, there are individual differences in the extent to which children make this evaluative distinction (Smetana et al., 2012). What leads some children to treat social-conventional transgressions more like moral transgressions? According to a recent proposal, normative evaluations are influenced by explanatory tendencies. Specifically, a bias to explain phenomena via inherent features (e.g., roses are beautiful; Cimpian & Salomon, 2014) leads young children to imbue descriptive norms (e.g., We give roses on Valentine's Day) with prescriptive value (e.g., It's good to give roses on Valentine's Day) (Tworek & Cimpian, under review). If the inherence bias in explanation gives rise to "should" inferences, then it might lead young children who exhibit a stronger inherence bias in their explanations to judge social-conventional transgressions (e.g., a boy wearing nail polish) as wrong in a stronger sense than anticipated by prior work (e.g., Helwig & Turiel, 2011), with quasi-moral force. Data with 4-7 year-olds supported this hypothesis: children with a greater bias toward inherent explanations were more likely to judge a norm deviation as wrong and punishment-worthy, and less likely to judge the norm as authority- and context-dependent (believing, for example, that it's wrong for boys to wear nail polish even if there's no rule). These findings suggest that the boundary between children's moral and social-conventional judgments is more permeable than previously thought and may help to explain individual differences in this moral/conventional distinction.

PC-024

The emergence of leadership in young children

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Children take on different roles in a group and show dominance or follower behaviour early in life (Parton 1933; Segal et al, 1987). We explore whether preschoolers are also able to take the lead and organize a group by influencing the behaviour of others and

whether factors other than dominance determine who takes on leadership roles.

Three-year-olds and five-year-olds, in groups of three, participated in a “magic tree” construction task in four conditions. The group was instructed to assemble the tree together. In each group, the dominant child was determined ahead of the test; a different child was randomly chosen to be a target child, whose competence and/or motivation we manipulated.

During the training phase, the target child either (i) spent some time reading a book with the experimenter (baseline); (ii) was promised a reward for building the tree (motivation); (iii) was shown how to assemble the tree (competence); or (iv) was both promised a reward and shown how to assemble the tree (motivation-competence). We coded every child’s task-related actions and leadership behaviour (i.e. organizing others by instructing or by establishing rules during the test).

Preliminary data suggest that dominant children tend to be more active with regard to the task, but less likely to show leadership behavior compared to children whose competence had been enhanced. Extrinsic motivation has no effect on the emergence of leadership behavior but increases the number of leadership roles taken on when added on top of competence.

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PC-025
Infants distinguish between dominance and authority

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In the literature on adult morality, a fundamental distinction is drawn between dominance (a social asymmetry in which a dominant individual prevails over subordinates in competitive situations) and authority (a social asymmetry in which the power of an authority figure over subordinates is deemed rightful or legitimate by all parties involved). We examined whether 21-month-olds already distinguish between dominance and authority. Specifically, would infants hold different expectations about subordinates’ willingness to comply with an order given by a leader (authority condition) as opposed to a bully (dominance condition)?

Infants saw computer-animated events involving geometric characters. In the familiarization event shown in the authority condition, three subordinates played with a ball until their leader arrived; the subordinates bowed to her and offered her the ball. In the test events, the leader ordered the subordinates to go to bed. In the disobedience event, the subordinates complied while the leader watched, but disobeyed after she

left; in the obedience event, the subordinates continued to comply after the leader left. Infants in the dominance condition saw identical events except that the leader was replaced by a bully; in the familiarization event, the bully hit the subordinates and stole their ball. Preliminary results indicate that infants in the authority condition look reliably longer at the disobedience than at the obedience event, whereas infants in the dominance condition look equally at the two events. These results suggest that infants expect subordinates to obey authority figures even in their absence, but hold no such expectation for bullies.

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PC-026
Children's conformity to their group members' prosocial and antisocial behavior

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Children have a strong tendency to conform. Despite better knowledge, they conform to their peers' statements (Haun & Tomasello, 2011) and sometimes even to their peers' immoral behavior (Engelmann et al., under review). However, so far no study has investigated children's conformity to their group members' prosocial and antisocial behavior. Furthermore, hardly anything is known about how conformity might conflict with children's potential desire to manage their group's reputation. The current study therefore investigates how watching an ingroup or outgroup member engage in a prosocial or antisocial act influences 5-year-olds' own subsequent behavior. First, children are allocated into one of two minimal groups and receive a number of valuable resources. They then observe how either their ingroup or their outgroup members engage in prosocial sharing behavior or antisocial stealing behavior. In the prosocial condition, their ingroup members share most of their resources by putting them in a donation box, while their outgroup members each steal a resource from the donation box. In the antisocial condition, children's ingroup member steal a resource, while their ingroup members share most of their resources. Subsequently, the experimenter turns away and children themselves have the opportunity to take resources from or put resources into the donation box. We hypothesize that generally, children will be more likely to conform to their ingroup members' actions, but have no prediction whether this effect will be stronger for prosocial or antisocial behavior. Data collection is in progress and results will be presented on the poster.

PC-027**The interpretation of Hungarian preverbal focus sentences by children and its correlation with the maturation of understanding others' epistemic states**Andrea Balázs¹, Anna Babarczy^{1,2}, Viktória Csink³¹ Budapest University of Technology and Economics, Hungary² Research Institute for Linguistics, Budapest, Hungary³ Central European University, Budapest, Hungary

The study looks at the development of the interpretation of a Hungarian scalar implicature-type construction, in 3 to 8-year-olds and attempts to find cognitive abilities correlating with the observed developmental trajectory. In binary truth value judgment tasks even 9-year-olds have been found to accept sentences with scalar implicature expressions even if they are underinformative in the given context. In one approach, pragmatic competence leaning on the ability to derive the speaker's non-literal meaning has been associated with the development of the ability to attribute mental states to others.

In our experiment children's competence in deriving the implicature that the Hungarian preverbal focus construction gives rise to is measured in a ternary sentence-picture verification task. Children were allowed to give "neither true nor false" responses. All critical sentence stimuli have the same focus structure while the picture stimuli vary between exhaustive, non-exhaustive and contrafactual conditions. The first results revealed that children produced different response pattern than adults. Despite this difference, analysis of individual data showed that the consistent pattern of discrimination between exhaustive, non-exhaustive and contrafactual conditions may be present even in younger children. In order to find out whether these individual differences may be explained by differences in non-linguistic factors such as mentalisation, we tested the correlation between the response patterns and the ability to understand others' epistemic states. This ability was measured by a non-verbal intention attribution task. Attributing epistemic states to others turned out to be a better predictor of focus interpretation than chronological age.

PC-028**Electrophysiological responses to phonetic landmarks in infant and adult directed natural speech**Júlia Simon^{1,2}, Annamária Kovács^{1,3}, Miklós Török⁴, István Winkler^{1,5}, Gábor Háden¹¹ Research Centre for Natural Sciences, Hungarian Academy of Sciences, Budapest, Hungary² Department of Cognitive Science, Budapest University of Technology and Economics, Budapest, Hungary³ Department of Telecommunication and Media Informatics, Budapest University of Technology and Economics, Budapest, Hungary⁴ Department of Obstetrics-Gynecology and Perinatal Intensive Care Unit, Military Hospital, Budapest, Hungary⁵ Institute of Psychology, University of Szeged, Szeged, Hungary

Previous studies suggested that infant directed (ID) speech facilitates word segmentation and phonetic category learning, although the mediating mechanisms are not fully understood. Here we examine the electrophysiological responses of adults and newborn infants to salient acoustic/phonetic events within continuous infant and adult directed (AD) speech. Acoustically salient events were identified using a skewness based computational model, which provides a good correspondence with phonetic landmarks. Two different sentences uttered by a female and a male speaker in two different speech modes (ID or AD) were presented 25 times, each while EEG was recorded. In the adult group, the event-related brain potentials varied together with the type of acoustic/phonetic events. The events that elicited a distinctive response in infants corresponded to those eliciting the most prominent response in adults. However, in infants, the response was only significant for female ID speech. We conclude that newborn infants probably process a combination of salient prosodic/phonetic cues within continuous speech.

PC-029

Verbal dyspraxia: The tip of the iceberg

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Verbal dyspraxia is not uncommon in preschool years. It refers to difficulty in making and co-ordinating the precise articulatory movements required in the production of clear and fast speech. The neuropsychological study shows the complex deficit also represented in oral, ideomotor, ideational, constructive dyspraxias, facial or oral synkineses, slow pace of all complex movements. The EEG study in all cases shows the residual & functional changes clear focused on left hemisphere. The complex habilitation program for children from 4 to 7 years was schemed out and approbated. As it is well known that neural motor system of children is active during production of own and perception of others actions [Marshall & Meltzoff, 2011] the habilitation program starts from the exercises performed together with adult specialist. As the interplay of social, cognitive and motor development seemed to be significant [Prinz, Beisert, & Herwig, 2013], special attention was paid to speech accompaniment to every group of movements. We conclude that 2-month intensive training shows its efficacy in increasing the speed of gross and fine motor, oral motor and articulation skills.

PC-030

Multilingual children's sensitivity to referential cues in fast mapping: Evidence from 54-month-old monolinguals, bilinguals, and trilinguals

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Recent research has demonstrated that bilingual children are better able than monolingual children to use referential cues (e.g., gaze, pointing) to locate an object [Yow & Markman, 2011, 2015] or to categorize objects [Brojde et al., 2012]. Here, we investigated how language-learning experiences affect children's use of referential cues in fast mapping. 54-month-old English monolinguals ($N = 13$), English-Mandarin bilinguals ($N = 25$), and English-Mandarin-LanguageX trilinguals ($N = 22$) completed a word learning task [Gliga et al., 2012]. Children saw 8 video clips each consisting of a teaching phase, a referent test (RT), and a mutual-exclusivity test (ME;

counterbalanced). In each clip, a target novel object (static) was paired with a salient novel distractor (moving). During the teaching phase, an experimenter turned her gaze toward the target object and labeled it with a novel word (e.g., "Blicket"). During RT, children were asked, "Where is the Blicket?" (expected target object). During ME, children were asked, "Where is the Plume?" (new novel label; expected salient object). Kruskal-Wallis tests indicated a significant effect of language group in expected responses in the referent test, $H(2) = 6.52, p = .038$. Both bilinguals ($M = 6.84$) and trilingual ($M = 6.91$) outperformed monolinguals ($M = 5.62$; no differences between bilinguals and trilinguals). Null results were found in the ME test. In addition, eye-tracking data showed that monolinguals looked at the target object significantly less than bilinguals during the teaching phase, suggesting bilingual children were better at following others' gaze and paid more attention to the referred object. Thus, exposure to multiple languages may heighten children's sensitivity to referential cues in learning.

PC-031

Bilingualism in children with autism: Detrimental or beneficial?

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This research reports on two studies exploring the impact of bilingualism on the development of children with autism. We first examine whether there is evidence for an (increased) language delay as a consequence of bilingualism. We then explore bilingual families' experiences, contrasting families having children with and without autism.

In study one, data from baseline assessments taken during a recent randomised controlled trial were re-analysed, comparing a sample of children (mean age = 4.2 years) with autism raised in bilingual households ($N = 15$) with a monolingual group ($N = 15$), matched on age, ADOS scores and SES. We found no significant group differences in parent-report measures of language or social communication.

In study two, interviews were conducted with bilingual parents with either a child with autism ($N = 17$), or a typically developing child ($N = 18$). Parents with a child with autism felt that bilingualism would hinder their child's linguistic development, exacerbating language delays. However, parents also identified benefits of bilingualism, particularly in flexible thinking, communication skills and the provision of high quality linguistic and social input. Parents felt less linguistically restricted when interacting with their child using their native language and felt that this facilitated a strong emotional bond with their child.

These studies demonstrate no evidence of a detrimental consequence of being raised in a bilingual household, while showing that parents have concerns. Moreover, our findings point towards considering factors such as family coherence and community integration, as well as cognitive and language development, in future research in this field.

PC-032
Heuristics and biases in non-compositional language development: Irony vs. metaphor

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Background: In our empirical study we investigate the cognitive developmental background of non-compositional processing, focusing on two common forms of polysemy: metaphor and irony.

Method: We investigate preschoolers' linguistic performance with semantic and pragmatic tasks (simile, metaphor, and three irony trials: irony; irony with surface cue; and irony-control task). Success in the linguistic trials is viewed in relation to children's mentalization skills tested with first- and second order False Belief Tests to see if ToM skills predict success in pragmatic competence.

Findings: [1] The results suggest that preschoolers decode irony with more success than metaphor, and apparently rely on different heuristics when interpreting the two polysemous forms. Irony is interpreted on the basis of certain biases triggered by surface cues and ostensive signals (Csibra, 2010; Alberti, 2011) like prosody, salient intonation patterns, social-cognitive and contextual factors. Thus, irony processing is apparently based on different heuristics than that of metaphor, yielding a "take the opposite meaning" strategy.

[2] This finding also questions traditional views in Gricean pragmatics, where the two are seen as belonging to the same cognitive category: to the infringement of the maxim of quality (Brown-Levinson, 1978).

[3] Our results also reveal that irony is interpreted considerably earlier than previously thought, thus defying long-standing views in literature (Gibbs, 1994) suggesting that it is stabilized between 8-13 years of age, considerably later than that of metaphor (4-5 years).

[4] The findings also indicate that non-compositionality has a number of levels, resulting in a matrix of several stages of linguistic compositionality reflecting graded salience (Giora, 2001) and cognitive complexity of interpretation.

PC-033
An exploratory eyetracking study on numerical discrimination with 3- to 6-month-old infants

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The development of numerical abilities in young infants has been the focus of attention to students of human cognitive development for several decades. Current research (Xu & Spelke, 2000; Uller et al., 2013) investigates the role of ratio in numerical discriminations with 6- to 10- month-old infants. The aim of this study is to examine 3- to 6-month-old infants' ratio assessment with the use of an eye-tracker. This methodology has been employed to investigate iconic memory (Blaser & Kaldy, 2010); goal directed action (Corbetta et al., 2012); perceptual learning (Johnson et al., 2004); face processing (Liu et al., 2010; Franck, Amso, & Johnson, 2014), amongst others, but little evidence exists that numerical discrimination has been studied with the use of an eye-tracker (cf. Ceulemans et al., 2012 for an initial version of a 1v3 discrimination with 8-month-olds). Participants were twenty 3- to 6-month-old infants tested in the Baby Research Unit at Kingston University. The experiment consisted of two sets of dots presented on the left and right of the visual field at the same time in the following ratios: 1:2 (1 v 2, 2 v 4, 4 v 8), and 2:3 (2 v 3, 4 v 6, 6 v 9). Results show a clear pattern between the discrimination of small and large numbers, thus providing never before shown support for the existence of two systems of counting early in infancy. The entailments of such results will be discussed.

PC-034
Learning the association between a context and a target location in infancy

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Extracting the statistical regularities present in the environment is a central learning mechanism in infancy. For instance, infants are able to learn the association between simultaneously or successively presented visual objects (Fiser & Aslin, 2002; Kirkham,

Slemmer, & Johnson, 2002]. The present study extends these results by investigating whether infants can learn the association between a target location and the context in which it is presented. To this aim, we used a visual associative learning procedure that is reminiscent of the contextual cuing paradigm, in infants from 8 to 12 months of age. In two experiments, in which we varied the complexity of the stimuli, we first habituated infants to several scenes in which the location of a target [a cartoon character] was consistently associated with a context, namely a specific configuration of geometrical shapes. Second, we examined if infants learned the covariation between the target location and the context by measuring looking times at scenes that respected or violated the association. In both experiments, results showed that infants learned the target-context associations, as they looked longer at familiar than novel scenes. In particular, infants learned the covariation between the target location and the most proximal context, namely the most frequent adjacent shapes. These results support the existence of a powerful and versatile statistical learning mechanism that may influence the orientation of infants' visual attention towards the areas of interest in their environment at early developmental stages.

PC-035
Pupil dilation probes the representations of same and different in infancy

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Whereas many experimental results suggest that young infants represent the relation same, there exists no convincing evidence that pre-lexical infants represent the relation different. Using pupillometry (Hochmann & Papeo, 2014), we asked whether infants can learn to predict that the last syllable of a sequence is the same as the previous syllables, or that the last syllable of a sequence is different from the previous syllables. Eleven-month-old infants sat in front of an eyetracker, watching a cartoon controlled for luminance. In Group 1, 75% of trials consisted in 4 identical syllables [AAAA] whereas the last syllable was different in 25% of trials [AAAB]. In Group 2, the proportions of trial types were inverted: 75% of trials followed the AAAB structure and 25% the AAAA structure. In both groups, syllables varied across trials, so that a response to infrequent sequences would suggest that infants learned and generalized an abstract structure based on the relations same and different.

A cluster mass test found a main effect of Sequence Frequency between 1150 and 1966 ms: infants' pupils dilated more in response to infrequent than to frequent

sequences; $p = .028$. No main effect of Group and no significant interaction were observed. However, planned comparisons found a significant difference between frequent and infrequent trials only in Group 1; $p = .03$. No significant difference was found in Group 2. Thus infants react to a violation of the structure of the frequent sequence. Moreover, these results may constitute the first evidence that pre-lexical infants represent the relation different.

PC-036
Argument selectivity in children's peer discussions

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Recent accounts characterize reasoning as a social skill of effectively producing and evaluating arguments in conversations (Mercier & Sperber, 2011; Tomasello, 2014). Previous research has shown that when competing with peers, both 5- and 7-year-olds produce fewer arguments than when they cooperate. In this study, we investigated two factors that may reduce argument production in competitive contexts: failing to search for evidence vs. strategically withholding arguments. 72 pairs of 5- and 7-year-olds were asked to build a zoo together and were presented with two cages, one belonging to each child. Both cages contained unconventional items (e.g., alarm clock). The reward scheme was either cooperative ["finding nice homes for all animals"] or competitive ["getting most animals to your side"]. Critically, one child received training beforehand, playing the game with the experimenter and learning three critical arguments (e.g., "The bear goes to the alarm clock, so it wakes up from hibernation in spring") that required animals to be placed in the naïve child's cage, and thus benefitted the naïve child in the competitive context. We coded how many of the critical arguments the trained child reproduced. 7-year-olds in the competitive condition reproduced less of the critical arguments than in the cooperative condition, whereas no difference was observed in 5-year-olds. So 7-year-olds withheld critical arguments more often than 5-year-olds, therefore adapting better to the exigencies of competitive argumentation. Together, previous and present results suggest that between 5 and 7 years, discursive goals gain importance for argument production, and cooperative contexts elicit objective argumentation.

PC-037

Explanation types and children's responses to why-questions

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Around the age of 3, children ask explanatory questions particularly frequent (Chouinard, 2007). Research shows that children's explanatory reasoning is triggered by surprising facts or anomalies (Isaacs, 1930; Legare, Gellman & Wellman, 2010). Both children and adults use certain types of explanations as answers to why-questions. In everyday thinking, we justify the decision for a particular explanation type by context or with domain-specific knowledge. However, the question remains, whether a heuristic scheme or an algorithmic-level account also can be identified for such inferences to the best explanation (Lombrozo, 2012). To explore this question, we conducted a study with 38 kindergarten children (2 to 6 years) and examined their explanatory answers to why-questions. Using a design inspired by Frazier, Gelman & Wellman (2010), we presented children with a series of 8 pictures of situations which differed with regard to their surprise level (e.g. horse on a kitchen table [high surprise level]), cat jumping towards a bucket [low surprise level]). Children were asked simple why-questions about the situation ("Hm. What do you think? Why doesn't the table collapse?"). Children's answers were coded into 7 categories (non-explanatory responses and 6 explanation types) and matched against the surprise level of the situation. Results show that children are sensitive to the surprisingness of a situation. Dispositions and mechanisms are preferred as explanation types if situations are more surprising. Single causes serve as explanations for less surprising situations. These findings suggest that the notion of surprise could be central to algorithmic-level accounts of explanatory reasoning.

PC-038

Children's verbal reasoning about their own spontaneous experiments during play

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Preschoolers spontaneously experiment during free play (Cook, Goodman, & Schulz, 2011), and, when queried, demonstrate learning from these experiments (Bonawitz, van Schijndel, Friel, & Schulz, 2012). However, whether children would choose to articulate

hypotheses for such experiments, or what they learned from them, remains unknown. In Experiment 1 ($N = 50$), 4-6-year-olds played with blocks that activated a "machine" (cf. Cook et al., 2011) in a touchscreen-tablet game. Many children (70%) generated controlled experiments, disambiguating cause-effect relationships, and 51% of these children described their discoveries in response to open-ended questions after their play (e.g. "what did you find out when you were playing just now?"). In Experiment 2, we asked 4-6-year-olds what they wanted to find out ($N = 25$) or do ($N = 25$) during their play, freezing game play and delivering these questions just after children performed half of a controlled experiment. Many children mentioned the effect of the blocks on the machine (46% find out, 38% do). In particular, 31% of children in the find out condition said they wanted to understand specific cause-effect relationships, while only 6% children in the do condition mentioned plans to disambiguate specific causes. The rates of children's controlled experimentation and self-report of learning from these experiments were comparable to those in Experiment 1, suggesting that children's experimentation and learning was unaffected by questioning during play. More broadly, these findings suggest that young children can appreciate and articulate the significance of causal hypotheses, action plans, and discoveries during their play.

PC-039

Sequential planning in preschool children

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Future thinking is the capacity that allows imagining ourselves in a future situation. Pre-school children have been shown to succeed in tasks that involve choosing a tool for a later use and, as such, authors have concluded that by the age of 5, children can make decisions with the future in mind. Despite these findings, it is still an open question whether young children can imagine more than one future event, mentally sequence them and act accordingly so they can later obtain a reward. The aim of this study was to test this possibility and investigate when in development this capacity might emerge. I presented 3-, 4- and 5-year-old children with a tool-use planning task involving two different events—defined by two different spatial locations (i.e., testing rooms). In order to succeed, children not only had to choose the correct tool but also to correctly plan the order of the events (e.g., the order in which they wanted to visit the two rooms). Four and 5-year-old children succeeded in this task and 3-year-olds failed to do so. Memory demands and task difficulty cannot account for these findings. I will discuss these results in the context of future thinking and temporal reasoning.

PC-040**Why be patient?**Gladys Barragan-Jason¹, Cristina Atance²¹ Institute for Advanced Study in Toulouse, France² University of Ottawa, Canada

Patience in children has usually been studied using delay of gratification paradigms. However, another way to study patience is to look at behavioral strategies used by children when they are forced to wait without the idea of a reward as a motivator [e.g., sitting in the doctor's waiting room]. Therefore, the first goal of our study is to evaluate different measures of patience (delay gratification and behavioral strategies) in children aged 3-to-8 and investigate how these two measures relied on each other [e.g. behave patiently in a pure waiting paradigm may be linked to better performance at delaying gratification]. Because patience might also be related to other cognitive processes, the second goal of our study was to determine whether children who were the most patient were also those who succeeded in different cognitive and pro-social tasks. Preliminary results show a negative link between patient behavior and future thinking and altruism. These results have deep implications on the way to study patience in kids. In addition, investigating the possible impact of patient behavior on cognitive abilities might also be important and relevant in education.

PC-041**The effect of experience on children's tool innovation: Are corvids really better innovators?**

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The current experimental literature examining tool innovation in corvids [Weir et al., 2002] and human children [Beck et al., 2011] may confer an unfair advantage to the corvids and paint an inaccurate picture of how their respective tool-making capacities can be compared.

We noted that whilst corvids had the opportunity to use a premade hook tool in the task context before being required to innovate [Weir et al, 2002], children did not [Beck et al., 2011]. Therefore, in Study 1 we compared 4- to 7-year olds performance on the Beck et al [2011] version and the Weir et al [2002] version of the hook-tool innovation task. When given the opportunity to use a premade hook tool in the task context, children were significantly more likely to innovate a hook tool of their own ($p < .001$). We concluded that children perform as well as corvids when given a comparable task.

Studies 2 and 3 investigated further the role of prior experience on subsequent tool innovation. We manipulated whether children were allowed to use or only see a premade hook tool before being required to innovate. We also manipulated whether this information was given before or after attempting the task for the first time. Overall, no condition was significantly more beneficial than another, although the results did demonstrate that the same information [e.g. seeing a hook before attempting the task] is helpful to some children and not others. This is discussed in terms of individual differences and ideas for future research.

PC-042**Episodic memory as a prerequisite for online updates of model structure**David G Nagy^{1,2}, Gergo Orban¹¹ Wigner Research Centre for Physics, Budapest, Hungary² Eötvös Loránd University, Budapest, Hungary

Long-term explicit memory emerges from the interplay of two different memory systems: the semantic and the episodic memories. The rationale for having a semantic memory, i.e. constructing a concise model that reflects the structure of the world, which an organism (or learning agent) can store instead of the data samples is well established. According to normative theories, in a complex and structured environment that is capable of providing a practically infinite variety of possible experiences both compression and generalization from limited evidence is necessary to have an efficient representation that underlies efficient actions. However, this account leaves the question on the possible benefits of storing rich snapshots of actual experience in the form of episodic memories open. We propose that due to computational resource limitations, the brain faces an online learning scenario, where observations arrive sequentially and predictions have to be continuously updated. In this scenario, initial samples are in general misleading regarding the structure of the whole dataset. In cases where the initially assumed model structure is wrong, retaining a summarizing statistics instead of actual data samples would prevent reinterpretation of previous observations in light of new experience. We propose that episodic memory can resolve this fundamental problem of learning by retaining a limited and selected subset of data points and we demonstrate it on a simple formal model of categorization. This constitutes a normative computational argument for the existence of an episodic memory system and gives predictions on the dynamics long-term memory.

PC-043**How does interactive media exposure impact memory development in middle-childhood?**

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Interactive media (IM) has become a part of the context in which children develop (Blumberg & Fisch, 2013). As such, a growing body of literature has investigated the impacts of IM on various aspects of cognitive development including reasoning and executive functioning (e.g., Adachi & Willoughby, 2013; Flynn et al., 2014). However, minimal work has directly examined the effect of IM-exposure and gaming on episodic memory. The present study addresses this dearth in the research by considering the influence of tablet-based gaming on episodic memory encoding during middle-childhood. We propose that metacognition [i.e., conscious reflection on cognitive processes; Flavell, 1979] mediates a relationship between gaming and memory encoding. We examined differences in memory encoding during a two-week intervention that experimentally manipulated exposure to different types of gaming applications ($N = 58$, 50% female, $M_{\text{age}} = 8.41$). Children's memory encoding and metacognitive-skills were tested at three visits (baseline, after 1 and 2 weeks of game play), and in-home game play was tracked using screen capture recoding software. Results indicated differences in episodic memory encoding trajectories across the three visits based on type of games played; TimexCondition $F(2, 112) = 3.58, p = .03$, partial eta-squared = .06. Specifically, children who played games with high opportunities for metacognitive-experiences showed greater increases in memory encoding than children who played low opportunity games. Our results provide support for a model that describes metacognition mediating the effects of IM-exposure on change in episodic memory, and provide insight into the underlying mechanisms involved in the impact of interactive media on memory.

PC-044**Neural correlates of abstract representations in 5 month-old infants**

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From the early stages of development with the acquisition of language or social skills, to the later milestones of formal education such as reading or mathematics, children constantly have to abstract knowledge from just a few relevant experiences.

However, the mechanisms allowing this basic and distinctively human learning ability remain unclear. This study aims at characterizing what in the developing human brain allows such flexible learning. Using EEG, in an audio-visual task, we evidenced that 5-month-olds can extract and simultaneously represent multiple abstract speech structures. Interestingly, we show that although immature, the developing brain is not a passive system: the knowledge infants acquire modulates their neural responses, down to early sensory cortices. This finding differs from classical feed-forward models of development, as it suggests that learning is already supported by sophisticated feedback connections in very young infants.

PC-045**Electrophysiological evidence of phonetic normalization across coarticulation in infants**Karima Mersad^{1,2,3}, Ghislaine Dehaene-Lambertz^{1,2,3}¹ INSERM, U992, Cognitive Neuroimaging Unit, Paris, France² CEA, DSV/I2BM, NeuroSpin Center, Paris, France³ University Paris-Sud, Cognitive Neuroimaging Unit, France

We provide evidence supporting the hypothesis that infants share with adults a similar neural architecture suitable for computing phonetic representations. We recorded high-density event-related potentials (128 channels) while 3-month-old infants were listening to trials consisting of four CV syllables, each produced with a different vowel (/bX/ or /gX/). The consonant remained the same for the first three syllables, followed (or not) by a change in the fourth position. A consonant change evoked a significant difference around the second auditory peak (400–600 ms) relative to control trials. This mismatch response demonstrates that the infants robustly categorized the consonant despite coarticulation that blurs the phonetic cues, and at an age at which they do not produce these consonants themselves. This response was obtained even when infants had no visual articulatory information to help them to track the consonant repetition. In combination with previous studies establishing categorical perception and normalization across speakers, this result demonstrates that preverbal infants already have abstract phonetic representation integrating over acoustical features in the first months of life. We also present preliminary data showing that 3-month-old infants can easily learn to associate a consonant in CV syllables with a visual shape, suggesting that they may have access to individual phonemes within a syllable.

PC-046**Emergence of efficient inter-hemispheric communication in visual network during infancy**

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Vision is rapidly developing during the first postnatal months thanks to the maturation of visual pathways, from retina to associative cortical areas. Yet, when integration of both hemifields information becomes functional remains debated, since connection fibers of the corpus callosum splenium may be too immature early on to mediate efficient inter-hemispheric communication. To investigate this issue, we studied the evolution of EEG brain responses to visual face stimuli presented laterally, in 40 infants aged between 6 and 24 weeks old. Early contralateral hemispheric evoked responses (P1) appeared before ipsilateral responses, and the latencies of P1 and inter-hemispheric transfer decreased with infants' age. In a subgroup of 13 infants also studied with diffusion-MRI, we demonstrated that these functional changes rely on the structural maturation of underlying white matter pathways. Indeed, the speeds of P1 and inter-hemispheric transfer correlated with DTI markers of myelination in optic radiations and visual callosal fibers respectively, beyond infants' age. To further investigate the efficiency of visual information transfer, we evaluated whether face stimuli encoded in one hemisphere are considered as familiar by the other hemisphere, in an intra- vs. inter-hemispheric discrimination task. For left-hemifield stimuli, N290 and P400 (face-sensitive components) showed respectively significant larger and smaller amplitudes over right occipito-temporal regions for a new but not for the familiar contralateral face, relatively to the standard face, supporting efficient discrimination of new stimuli and efficient inter-hemispheric transfer. This effect correlated with age. Right-hemifield stimuli elicited no difference between conditions, suggesting an asymmetry of face processing during infancy.

PC-047**Can we measure anything non-verbally? A critical discussion of combined eye tracking and EEG**

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Many cognitive and social skills develop during early infancy. A combination of eye tracking and EEG makes it possible to measure these skills non-verbally from an early age on (using eye tracking) and to simultaneously investigate neural responses (Kulke et al., 2015). However, the co-registration of data is challenging. Using data from 80 infants between 1 and 8 months of age who were tested with combined eye tracking and EEG, this study critically evaluates this novel methodology. Infants completed an eye tracking version of an attention paradigm [Fixation Shift Paradigm, Hood & Atkinson, 1993] that measures the developing ability to shift attention, while EEG was recorded simultaneously. Although data loss is more likely when combining different methods, the data quality can be improved through simple adjustments, including improvements of the eye tracking signals in young infants, automation of the paradigm and minimization of the distortions of EEG data through eye movements. Different tips and tricks of co-registration will be reviewed. The current study shows that with these improvements, eye tracking and EEG can be combined to study attention development in infants and shows a development of neural responses in frontal cortex with age. The methodology and the improvements summarized here can be applied to different research areas that require non-verbal tasks, including early cognition and early social perception. It is suitable for pre-verbal infants and clinical populations with language impairments.

PC-048**Rapid development of dual task performance during early childhood**Taeko Harada^{1,2}, Tetsuya Shirokawa³¹ Hamamatsu University School of Medicine Research Center for Child Mental Development, Japan² The research institute for health sciences Nihon Fukushi University, Japan³ Faculty of Health Sciences Department of Rehabilitation Nihon Fukushi University, Japan

The ability of children to perform two tasks simultaneously is crucial in their cognitive development. The basic cognitive functions is known to develop during early childhood, however, the functional development of dual task processing is poorly understood. We examined performances of dual task processing by children aged 4 to 6. A total of 335

children (187 boys and 148 girls) participated in this study. All children performed the following three tasks: two single working memory tasks (WM), a merged task with the two single WM tasks (mixed-WM), and a dual task featuring the two single WM tasks (DUAL). The mean accuracies of participants were 17.4±23.8 % for age 4, 43.2±30.9% for age 5 and 64.8±23.9% for age 6. A 3 x 3 two-way ANOVA was employed with task condition (WM, mixed-WM, and DUAL) as a within-subject factor, age (4, 5 and 6y) as a between-subjects factor and accuracy as a dependent variable. The ANOVA indicated significant main effects of task condition [$F(2, 996) = 837.86, p < .0001$] and age [$F(2, 996) = 104.96, p < .0001$] as well as a significant interaction effect [$F(4, 38) = 44.36, p < .0001$]. Post hoc comparisons revealed significant differences between all age pairs only for the DUAL condition [$p < .0001$]. The results provided valid evidence that the ability of dual task processing remarkably grows during the early childhood.

PC-049

MetaLab: Power analysis and experimental planning in developmental research made easy

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MetaLab (metalab.stanford.edu) is a web-based tool that aggregates meta-analyses across different domains in language acquisition. MetaLab can be used for power analysis, experimental planning, and theory development. Currently, MetaLab includes 575 effect sizes and data from 11,627 children from 165 papers on 5 topics (phoneme discrimination, word segmentation, infant directed speech, pointing and language development, and mutual exclusivity). MetaLab is completely open and encourages contributions from researchers to expand and stay up to date.

Reproducible research requires experimental designs with appropriate statistical power. But with unknown effect sizes, sample sizes are difficult to determine prospectively. In developmental research, research is typically underpowered due to both low sample and low effect sizes (a typical word segmentation study has $N = 24$ and Cohen's $d = .2$). MetaLab allows researchers to estimate effect sizes and to select experimental design parameters that increase their likelihood of success. Critically, researchers can customize queries to the particular phenomenon, age, and method of planned studies.

Better effect size estimates are also important for theoretical progress. Existing meta-analyses reveal developmental trends within individual phenomena, but comparing these trends across phenomena is more difficult because of the wider range of tasks and ages. MetaLab provides a synthesis across different meta-analyses: a visualization of the relationship between the developmental trajectories of different phenomena in language development. This analysis provides an empirical analogue to classic "ages and stages" charts that show how different abilities overlap in developmental time, and highlights the interactive nature of language learning.

PC-050

An empirical and computational investigation of typical and atypical learning and knowledge representation

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Many studies on implicit and explicit learning compare atypically developing children simply with typically developing controls; yet cross-syndrome comparisons could reveal subtler clues to how knowledge is acquired, represented and accessed. Two tasks were designed to examine verbal and spatial abilities: an implicit verbal memory task and a visuospatial motivation task. Findings from typically developing children reveal different approaches to solve the visuospatial motivation task, congruent with the different phases of knowledge acquisition outlined in Karmiloff-Smith's (1992) Representational Redescription framework. Empirical testing is now including children with two genetic syndromes – Down and Williams syndromes – as they can be matched on overall IQ but present with opposite patterns of verbal and spatial abilities. The findings from these groups could reveal subtler performance differences than the focus on healthy controls, making it possible to gain a better understanding of the cognitive nuances underlying the two tasks. Data from all three participant groups are being used to explore learning algorithms for a novel computational model in order to identify how children represent/re-represent their changing knowledge. A combined empirical and computational approach, including a cross-syndrome comparison, could be key to understanding the underlying cognitive processes that support both implicit and explicit learning and access to learned information.

PC-051**An ethological approach to social evaluation**Judit Abdai¹, Ádám Miklósi^{1,2}¹ Eötvös Loránd University, Budapest, Hungary² MTA-ELTE Comparative Ethology Research Group, Budapest, Hungary

Social evaluation is a mental process underlying the avoidance of antisocial individuals (negativity bias) and preference toward prosocial partners (positivity bias) in cooperative context. Considering its importance in survival negativity bias is likely to be widespread among animals; however, we suggest that positivity bias may have emerged only in certain species due to the smaller cost involved. We argue that negativity and positivity bias (as the components of social evaluation) emerge independently and evolve later to a unified behaviour and cognitive system referred to as social evaluation. The ability to discriminate between antisocial and prosocial others has been investigated mainly in human and non-human primate species and dogs; however, there are a few data on the presence of negativity/positivity bias in client-cleaner reef fish interactions as well. The aim of the present review is to point out that the capacity for social evaluation is not necessarily restricted to humans alone, but it is likely to be more widespread in the animal kingdom. Unfortunately, comparative approach to social evaluation is hindered by procedural differences in experimental studies, although these could facilitate the investigation on its evolutionary origin.

PC-052**Rule learning from sequences of social and non-social stimuli in the Autism Spectrum Disorder**Roberta Bettoni¹, Chiara Turati^{1,2}, Chiara Pezzana³, Emanuela Bricolo^{1,2}, Hermann Bulf^{1,2}¹ University of Milano-Bicocca, Italy² Center of Neurosciences (Neuro-MI), Milan, Italy³ Associazione Nazionale Genitori Soggetti Autistici, ANGSA ONLUS, Novara-Vercelli, Italy

Rule Learning (RL) allows to extract and generalize high-order rules from a sequence of elements and plays a critical role in the acquisition of language and social routines. Despite the relevance of RL for linguistic and social abilities, surprisingly, no studies have investigated this mechanism in the Autism Spectrum Disorder (ASD), a disorder characterized by abnormalities in communication and social interaction. Here, we investigated RL in high functioning autistic individuals, examining their ability to extract

and generalize rule-like patterns from sequences of social and non-social stimuli. Using a forced-choice paradigm, two groups of adolescents, one with ASD ($N = 5$) and one with typical development ($N = 10$), were presented with triplets of stimuli organized in ABB or ABA patterns. Geometric shapes, upright-faces and inverted-faces were used as stimuli. During the test phase, a new ABB or ABA triplet was shown, and reaction times (RT) to recognize the rule were assessed. Preliminary results show that the control group was more accurate and faster in identifying the rule in the presence of geometric shapes than with upright and inverted faces. Conversely, the ASD group was slower in recognizing the rule with upright faces; moreover, the complexity of the rule modulated ASD participants' accuracy with upright and inverted faces. These findings provide evidence that ASD individuals are able to learn and generalize a high-order rule, and that their RL ability is modulated by the social nature of the stimuli.

PC-053**The relationship between implicit learning and risky decision making: A developmental perspective**Noémi Éltető¹, Karolina Janacsek^{1,2}, Andrea Kóbor³, Ádám Takács¹, Dezsó Nemeth^{1,2}¹ Institute of Psychology, Eotvos Lorand University, Budapest, Hungary² MTA-ELTE NAP B Brain, Memory and Language Lab, Institute of Cognitive Neuroscience and Psychology, Research Centre for Natural Sciences, Hungarian Academy of Sciences, Budapest, Hungary³ Brain Imaging Centre, Research Centre for Natural Sciences, Hungarian Academy of Sciences, Budapest, Hungary

The ability to acquire automatic, intuitive skills changes during development: it shows a declining pattern during lifetime, with the most significant drop being observable in adolescence (Janacsek et al., 2012). These ontogenetic cognitive changes might have important role in the development of the processes relying on the ability of learning probabilistic relationships. Here we aimed to investigate how the development of implicit learning affects the decision making process between 10 and 25 years of age. Implicit probabilistic sequence learning was assessed by the Alternating Serial Reaction Time (ASRT) Task. The Balloon Analogue Risk Task (BART), in which subjects inflate a virtual balloon that can either grow larger or explode, was used to measure risky decision making. In line with previous studies, we also found that the efficiency of implicit learning declines from childhood to early adulthood. Regarding decision making, participants showed a risk-averse pattern, resulting generally in suboptimal

performance in the BART. We found a significant moderate correlation between the learning performance in the ASRT task and the risk taking propensity in the BART. Thus, better implicit probabilistic sequence learning was associated with more optimal decisions. However, there were no age-related differences in decision making. This result might be explained by strategy differences: while pre-adolescent participants relied more on their intuitive abilities during decision making, adolescents and young adults achieved similar performance using rather explicit strategies. In sum, our findings shed light on how the relationship between implicit abilities and risky decision making changes from childhood to early adulthood.

PC-054 Relation between executive functions and school readiness

Hazal Celik, Deniz Tahiroglu

Ozyegin University Istanbul, Turkey

In the current study the relations between hot and cool executive functions (EF) and school readiness (SR) were examined in preschool children using parent questionnaires and standardized behavioral tasks. 54 preschool children between the ages of 48 to 72 months (31 girls; $M_{\text{age}} = 59.94$, $SD = 6.95$) and their mothers took part. Children were administered cool EF tasks to assess inhibitory control, working memory, set-shifting, and planning, in addition to hot EF tasks. School readiness was measured with literacy and mathematical knowledge tests. Parents also provided data about their children's EF via the Behavior Rating Inventory of Executive Function Preschool Version [BRIEF-P; Gioia, Andrews, Espy & Isquith, 2005], Children's Behavior Questionnaire [Rothbart, Ahadi, Hershey & Fisher, 2001], Learning Related Behaviors Questionnaire [McDermott et al., 2002] and School Readiness Survey [Baydar, 2011] to assess the child's school readiness. As predicted, results showed that children's mathematical abilities were correlated with their inhibition and working memory abilities, $r_s(43) = .45$ and $.48$, p 's < .002, respectively. Letter knowledge was correlated with inhibition scores, $r(41) = .40$ $p = .007$. However, hot EF tasks were not correlated with any of school readiness measures. Parent-reported children's learning related behaviors were also correlated with parent reported EF. Mother's responses on school readiness survey and children's performance on literacy and math were correlated r s (d fs ranging between 40 and 28) ranging between .33 and .53 p s < 0.03. The results revealed that cool EF, rather than hot EF, was a better predictor of SR.

PC-055 Game-Boards for Number Understanding

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Interventions with board games offer durable improvements in children's numerical knowledge. They provide a range of kinesthetic, visuospatial, and temporal cues that all correlate with number magnitude. Notably, when training children with larger numbers (1-100), researchers have used a square board with numbers arranged in a 10x10 array [Laski & Siegler, 2014]. Besides the magnitude cues listed above, this board thus also emphasized the base-10 structure of numbers.

We designed a study to assess what aspects of game boards contribute to improve children's numerical knowledge. Over the duration of 2 weeks, first graders played 4 sessions on one of three different 0 to 100 board game layouts: SPIRAL, BASE-10 or BASE-9 board. All boards provided a mapping of number to space, as well as kinesthetic and temporal cues to number magnitudes. In addition, on the BASE-9 board, the mapping of number to space followed a regular structure by rows; and in the BASE-10 board, this structure was aligned with the base-10 structure of number words.

Children from all three groups showed improvement on a range of numerical tasks. However, classmates in the BASE-10 and BASE-9 groups showed greater improvement on number comparison, indicating that children benefitted from the magnitude cues provided by the game only when the mapping of number magnitude to space was linear spatially organized. In addition, children in the BASE-10 group showed greater improvement than other groups in a counting task, perhaps because the board emphasizing the base-10 structure of numbers helped them memorize the counting list.

PC-056**Combining knowledge across domains:
a study of mindreading and counting ability**Zoltán Jakab¹, Szabolcs Kiss², Monika Molnár¹, Pál Szabó¹, Klára Tóthrn¹¹ Eötvös Loránd University, Budapest, Hungary² University of Pécs, Hungary

We examined kindergarteners' ability to combine their knowledge in two domains: mindreading [false belief attribution], and counting. Four tasks were administered to three age groups: 3-4, 4-5, and 5-6 year olds. False belief attribution was assessed by the Smarties task; counting level was established by the Give-a-Number task. In addition, we used a numerical decentration (ND) task, and a false belief with counting (FBC) task. In the former, 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 thought there were on the table. In the FBC task subjects saw short videos in which an assistant enters a room with a box on a table, leaves a certain number of balls in the box, then leaves. Next, another assistant enters, leaves one ball in the box then leaves. Finally, the first assistant returns, and reaches in the box either after peeking into the box or without peeking. Subjects were asked how many balls the assistant thought there were in the box. We found a longer delay between mastering the FB and GN task vs. managing the FBC task. Whereas the overwhelming majority of children between 4-6 years solved both constituent tasks, only a few of the 5-6-year-olds solved the FBC task. The ND task proved easier, and did not require the mastery of the FB task.

PC-057**Exploring the role of different working memory
components in mathematical skills in 5 to 6 years-old
children**

Andrea Díaz-Barriga Yáñez, Daniel J Carroll

The University of Sheffield, Sheffield, UK

Mathematics is a complex high-level skill that depends on a number of cognitive abilities (Träff, 2013), furthermore it is one of the strongest predictors of later academic and career outcomes (Roberts et al., 2011; Cragg & Gilmore, 2014; Purpura & Ganley, 2014). Nevertheless, the cognitive mechanisms that underpin this skill are still unclear, especially the relative contributions of domain-general abilities such as working memory

(WM). Based on Baddeley and Hitch's multi-component model, this study aims to explore the role of different WM components in children's mathematical skills. A sample of 78 children (39 female) between 59 and 79 months ($M = 69$, $SD = 5.3$) completed three different WM measures [one for each component], two mathematics tests (Numerical Operations and Mathematical Reasoning), and a vocabulary test (BPVS-II). Results of a hierarchical regression indicated that vocabulary and central executive contributed unique variance in the Numerical Operation test ($F[2, 75] = 24.96$, $p < .001$, $R^2 = .40$, $f^2 = .67$), whereas the central executive, the visuo-spatial sketchpad and vocabulary contributed unique variance for Mathematical Reasoning ($F[3, 74] = 13.45$, $p < .001$, $R^2 = .35$, $f^2 = .55$). The current findings demonstrate that children's ability to solve a problem presented in either written or oral form relies on their central executive, and for more complex problems involving verbal and visual prompts, children may also rely on their visuo-spatial sketchpad. On the other hand, student's ability to apply their math skills may depend on their understanding of the vocabulary utilized in instructions and word problems, yet the role of vocabulary needs further investigation.



PRE-CONFERENCE
SESSION

Eye tracking data quality, validation, and fixation classification

Organizer:

Brian Sullivan, Tobii Technology AB, Stockholm, Sweden

Part I – Presentation (8:45 – 10:00)

Eye tracking in developmental psychology has many applications. Successful studies require attention and care to obtain reliable data and properly process and analyze. I will discuss factors involved in decreasing eye tracking quality and common approaches to minimize them. Additionally, I will discuss best practices for eye tracking data validation, including metrics and visualization. Lastly, fixation classification will be covered including theory behind some common algorithms, appropriate situations where fixation classification is useful and ramifications for detecting gaze behavior in areas of interest (AOIs).

Part II – Hands-on workshop (10:20 – 12:00)

This workshop will have a hands-on session where we will further focus on presenting best practices when performing eye-tracking studies, and provide the opportunity for participants to try out different eye trackers, analysis tools and eye tracking setups. We will collect data and examine eye tracking data with a focus on relating to topics covered in the lecture, in particular highlighting approaches in eye movement classification and use of AOIs.



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RESTAURANTS
& MAPS

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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.

1. Arriba Taqueria

1067, Teréz körút 25.
www.arriba.hu
Mexican

2. Barokko Club & Lounge

1065. Liszt Ferenc tér 5.
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

6. Cactus Juice Pub & Restaurant

1061 Jókai tér 5.
www.cactusjuice.hu

7. Csirke-fogó

1065 Bajcsy Zsilinszky u. 7.
www.csirkefogo.hu
Fast food

8. Dimitrisz Restaurant

1067 Eötvös utca 25/a
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
Indian

14. Istanbul Turkish Restaurant

1067 Teréz Krt. 23.
www.istanbuletterem.hu
Turkish

15. Napos Oldal

1066 Jókai u. 7.
www.naposoldal.com/en/restaurant
Vegan/Vegetarian

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16. Parazs Presszo

1066 Jókai u. 8.
www.parazspresszo.com/node/119
Thai

17. Café Bouchon

1066 Zichy Jenő u. 33.
www.cafebouchon.hu
Hungarian

18. Funky Pho

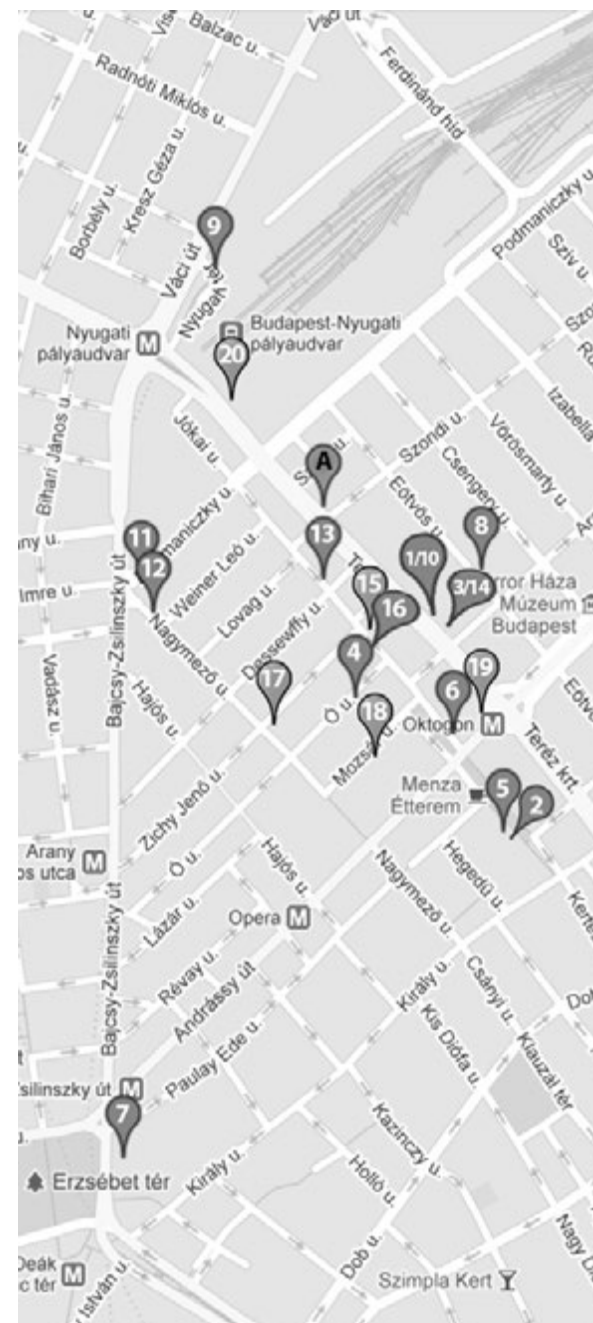
1066 Mozsar u. 7.
www.funkypho.hu
Vietnamese

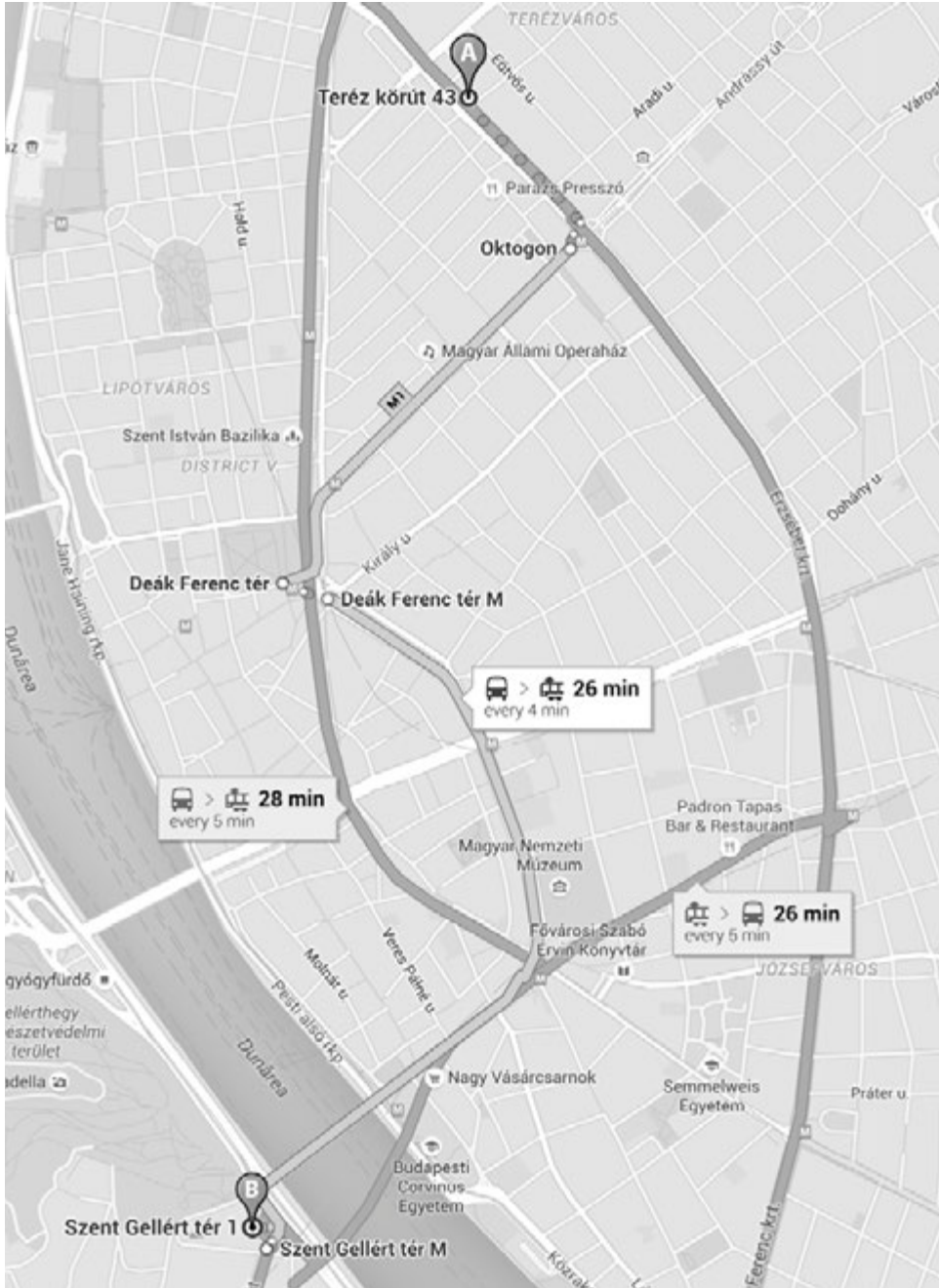
19. Bellozzo

1066 Oktogon ter 1.
www.bellozzo.hu
Italian

20. Nu Bor es Bisztronomia

1062 Tereztér, 55.
www.bisztronomia.hu
Hungarian





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