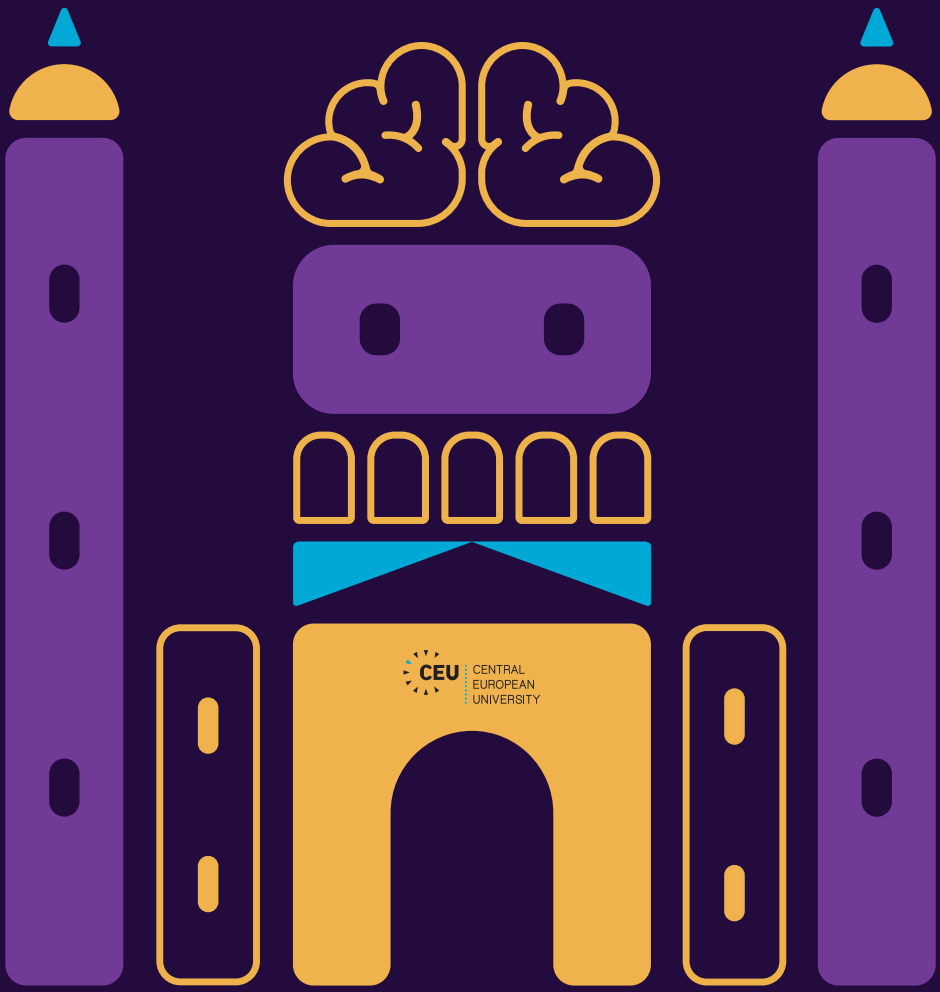
# BC3D

BUDAPEST
CEU CONFERENCE
ON COGNITIVE
DEVELOPMENT

2025



| | Thursday, January 9 | Friday, January 10 | Saturday, January 11 |
|---|---|---|---|
| 08:30 | **Preconference Tutorials session A** | | |
| 09:30 | | Invited talk 2<br>**Pierre-Yves Oudeyer**<br>*Auditorium* | Invited talk 3<br>**Antonia Hamilton**<br>*Auditorium* |
| 10:15 | Coffee Break<br>*Lobby* | | |
| 10:45 | **Preconference Tutorials session B** | Coffee Break + Group Photo<br>*Lobby* | Coffee Break<br>*Lobby* |
| 11:15 | | Paper session 2<br>**Social Cognition**<br>*Auditorium* | Paper session 4<br>**Action**<br>*Auditorium* |
| 12:15 | | Lunch Break | Lunch Break |
| 13:00 | Welcoming Remarks | | |
| 13:15 | Symposium 1<br>***Developmental Building Blocks of the Language of Thought***<br>*Auditorium* | Symposium 2<br>***Comparing Curiosity: Changes in Information-Seeking Across Development and Evolution***<br>*Auditorium* | Symposium 4<br>***New Insights in Infant Neuroscience***<br>*Auditorium* |
| 14:30 | **Poster Session A**<br>with coffee & snacks<br>*1st floor* | **Poster Session B**<br>with coffee & snacks<br>*1st floor* | **Poster Session C**<br>with coffee & snacks<br>*1st floor* |
| 16:30 | Paper session 1<br>**Exploration and Metacognition**<br>*Auditorium* | Paper session 3<br>**Word Learning**<br>*Auditorium* | Paper session 5<br>**Language**<br>*Auditorium* |
| 17:30 | Short Break | Short Break | Short Break |
| 17:45 | Invited talk 1<br>**Elizabeth Bonawitz**<br>*Auditorium* | Symposium 3<br>***Pragmatic Models of Early Communication: Facing the Developmental Challenge***<br>*Auditorium* | Paper session 6<br>**Object Representation**<br>*Auditorium* |
| 19:00 | **Welcome Reception**<br>19:00-21:00<br>*Lobby* | **Mulled Wine Reception**<br>19:15-21:00<br>*Rooftop Terrace* | **Gala Dinner & Closing Party**<br>20:00-03:00<br>*Marriott Hotel* |

# BCCCD 2025

Budapest CEU Conference
on Cognitive Development

## Program and Abstracts

**ORGANIZED BY**

Cognitive Development Center
Central European University

January 9-11, 2025
Budapest, Hungary
https://bcccd.org/

## CONFERENCE ORGANIZATION

The BCCCD is organized by the Cognitive Development Center at the Department of Cognitive Science, Central European University: https://cdc.ceu.edu/

## CONFERENCE CHAIRS

Maja Blesić, Maria Mavridaki

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Current members of the Cognitive Development Center at CEU and valued reviewers with expertise in areas related to cognitive development.

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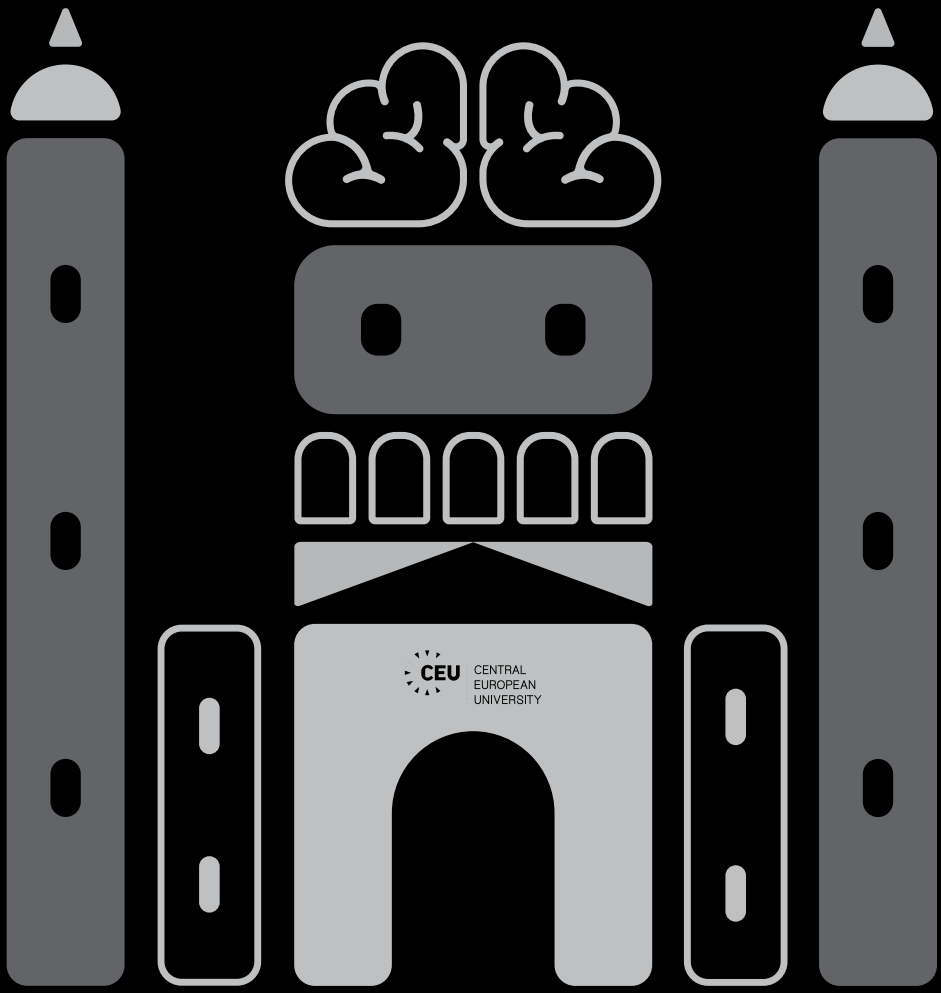

# SCHEDULE

# THURSDAY, 9 JANUARY

## 08:30-12:30 PRE-CONFERENCE EVENTS



## 13:00-13:15 BCCCD25 WELCOME

## 13:15-14:30 SYMPOSIUM 1



## 14:30-16:30 POSTER SESSION A



(with coffee & snacks)

# THURSDAY, 9 JANUARY

## 16:30-17:30 PAPER SESSION 1



## 17:30-17:45 SHORT BREAK

## 17:45-19:00 INVITED TALK 1



## 19:00-21:00 WELCOME RECEPTION

# FRIDAY, 10 JANUARY

## 09:30-10:45 INVITED TALK 2



## 10:45-11:15 COFFEE BREAK + GROUP PHOTO

## 11:15-12:15 PAPER SESSION 2



## 12:15-13:15 LUNCH BREAK

## 13:15-14:30 SYMPOSIUM 2



## 14:30-16:30 POSTER SESSION B



(with coffee & snacks)

# FRIDAY, 10 JANUARY

## 16:30-17:30 PAPER SESSION 3



## 17:30-17:45 SHORT BREAK

## 17:45-19:00 SYMPOSIUM 3



## 19:15-21:00 MULLED WINE RECEPTION

**(Rooftop terrace)**

# SATURDAY, 11 JANUARY

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# SATURDAY, 11 JANUARY

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## 17:30-17:45 SHORT BREAK

## 17:45-19:00 PAPER SESSION 6



## 19:00-19:15 CLOSING

## 20:00-03:00 GALA DINNER & CLOSING PARTY

**(Marriott Budapest Hotel)**

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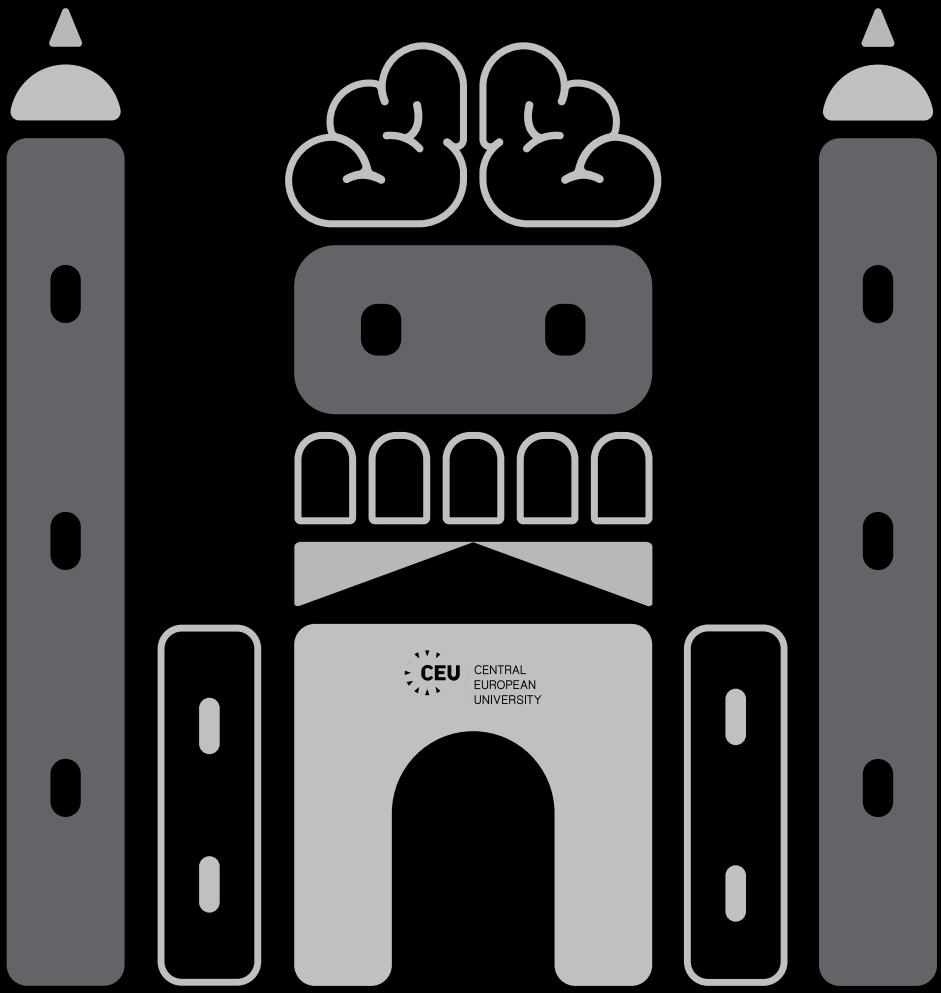

# PRE-CONFERENCE EVENTS

# PRE-CONFERENCE EVENT 1



## Bayesian models of science learning in Python

Thursday, 9 January 2025, 8:30 – 12:30

**Organizer:**

Lucas Lörch, DIPF Leibniz Institute for Research and Information in Education

Science learning is a highly relevant topic for the investigation of cognitive development. First, misconceptions about scientific phenomena follow a developmental trajectory. Second, science learning depends on metacognitive skills such as inhibition or cognitive reflection, that develop during childhood. Therefore, methods for investigating science learning can provide novel insights into cognitive development. The present tutorial introduces such a method, namely Bayesian modeling of science learning.

Bayesian inference is a method of statistical inference, i.e., a method of drawing conclusions from data. The central notion of this method is Bayes' theorem, which states that the probability that a hypothesis is true given some evidence (P(H|E), called posterior) is proportional to the product of the probability of the hypothesis (P(H), called prior) and the probability that the evidence would occur if the hypothesis were true (P(E|H), called likelihood). While Bayesian inference is a common method in empirical research, it can also be seen as a formalized model of science learning. The learner's prior belief (say, that heavier objects displace more water) is updated after seeing some evidence (say, that a lighter but larger object displaces more water). This approach is supported by previous research (Ullman & Tenenbaum, 2020; Colantonio et al., 2022).

The newly developed Python package "Bayesian Science Learning" (BaSciL) provides an easy-to-use and flexible tool for Bayesian modeling of science learning. It can be used in cases where children learn about scientific phenomena from experimental comparisons. Researchers upload a spreadsheet with information about experimental trials and participants' responses. The program automatically computes likelihoods of observed outcomes and learners' prior belief distributions and performs Bayesian updating. Because the functions are pre-built and run automatically, BaSciL makes Bayesian modeling accessible even to researchers unfamiliar with the Python programming language.

# PRE-CONFERENCE EVENT 2

## An introduction to Linear Mixed-effects Models in R



Thursday, 9 January 2025, 8:30 – 12:30

**Organizer:**

Cintia Bali, University of Pécs, Department of Cognitive and Evolutionary Psychology

Using Linear Mixed-effects Models (LMMs), also known as random effects models, to analyze data can be highly beneficial. However, their use is not widespread, partly due to the considerable variation in how LMMs are applied and results are reported, making it difficult to understand them better. In comparison to traditional methods like ANOVAs, using LMMs offers more flexibility as they can handle complex data structures, missing data, and unequal datasets. LMMs also allow for the inclusion of random effects, enabling control for potential confounding effects, such as variability between participants. These features can lead to a better understanding of the data and more accurate conclusions. Therefore, the tutorial aims to introduce LMMs and provide a framework for building models and reporting results in a standard manner.

# PRE-CONFERENCE EVENT 3



## Analyzing pupillometric data in R: A hands-on tutorial

Thursday, 9 January 2025, 8:30 – 12:30

**Organizer:**

Francesco Poli, University of Cambridge, Tommaso Ghilardi, Birkbeck University of London

Pupillometry—the measurement of pupil size and reactivity—is a valuable method in cognitive science for inferring cognitive and affective processes in both humans and animals. Changes in pupil size can provide insights into attention, arousal, and cognitive load, making it a powerful tool in developmental and comparative cognition research. However, analyzing pupillometric data presents challenges due to its complexity, including issues like missing data from blinks, noise, and the need for specialized statistical techniques.

This tutorial aims to demystify the process of analyzing pupillometric data using R, focusing on the PupillometryR package—a comprehensive toolkit designed to facilitate the cleaning, processing, and statistical analysis of pupil data. Participants will learn how to handle common issues such as missing data and noise, perform smoothing and filtering, and apply advanced modeling techniques like Generalized Additive Models (GAMs) which are particularly suited for time-series data inherent in pupillometry.

By the end of the tutorial, participants will have a practical understanding of how to preprocess and analyze pupillometric data in R. The hands-on approach ensures that attendees can apply these techniques to their own research, enhancing the rigor and depth of their data analysis in developmental and comparative cognition studies.

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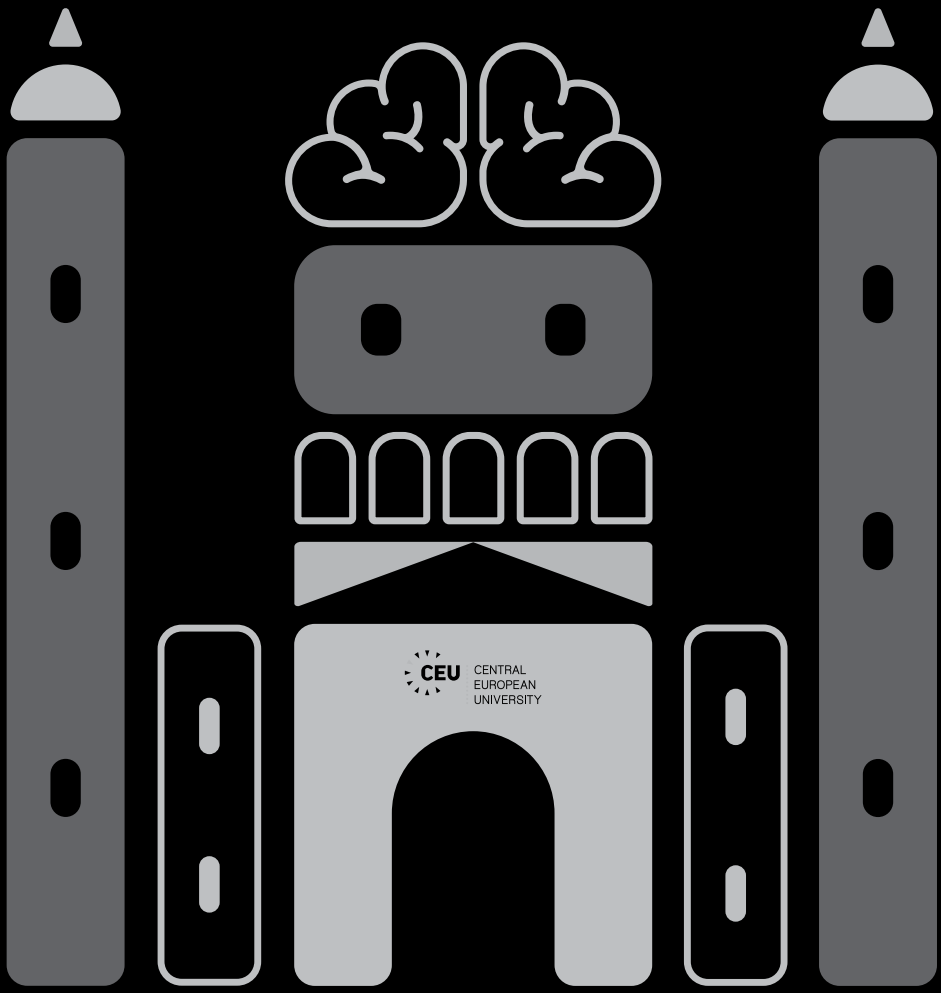

# INVITED PROGRAM

# INVITED TALK 1

## The power of prediction: Mechanisms of children's curiosity and learning

Thursday, 9 January 2025, 17:45-19:00



**Chair:**
György Gergely

**Presenter:**
Elizabeth Bonawitz, Harvard University, US

How might the act of predicting supporting children's exploration and learning? I will suggest that prediction is linked with curiosity (also known to support exploration and learning) via (at least) two related mechanisms. First, prediction might support learning because it draws attention to errors that follow the prediction -- leading to (a particular formalization of) surprise that is for accommodating new information. Second, prediction might support learning because generating a prediction could highlight a potential gap in knowledge (ala Lowenstein's information gap model) -- especially when predictions are uncertain and/or conflicting; this raises an expectation for information and subsequent brain response that supports learning. I will present results from several behavioral studies from infants through elementary years, bridging computational, physiological, brain, and behavioral methods that begin to identify the powerful mechanisms underlying learning and the supporting role of making predictions.

# INVITED TALK 2

## Curiosity-driven learning in human development: computational theories and applications in AI and education

Friday, 10 January 2025, 9:30-10:45

**Chair:**

Jonathan F. Kominsky

**Presenter:**

Pierre-Yves Oudeyer, University of Bordeaux, France

A remarkable feat of children's development is their autonomy, open-endedness, flexibility and efficiency at learning diverse skills under strongly limited resources of time and energy. In this talk, I will explain why and how curiosity mechanisms play a crucial role in such capabilities, leveraging computational models. I will discuss three theoretical perspectives: 1) the Learning Progress theory, its links with metacognition, how this accounts for self-organization of developmental structures, and how some of its predictions were confirmed in recent experimental paradigms with diverse populations; 2) Autotelic exploration, whereby individuals invent, select and pursue their own goals; 3) Language as a cognitive tool to boost creative curiosity-driven autotelic exploration. Beyond providing insights on human development, I will also show how this sets the ground for new forms of open-ended AI systems. Finally, I will show several projects and experimental results in classrooms transposing these insights in educational interventions aimed to foster and train curiosity in children, e.g. training curious question-asking.

# INVITED TALK 3

## Measuring social interaction in autism and across development

Saturday, 11 January 2025, 9:30-10:45

**Chair:**

Gergely Csibra



**Presenter:**

Antonia Hamilton, Institute of Cognitive Neuroscience, University College London, UK

Social interaction is important for learning, culture and human flourishing but research methods to quantify and understand social interaction are still limited. This talk will give an overview of some of the ways in which researchers can study dynamic social interactions in typical and autistic children and adults. First, I will describe a set of studies that examine the impact of being watched. The simple change from performing a task along to performing the same task with another person can impact both behaviour and brain activity in both autistic and neurotypical adults. Second, I will describe new research using wearable sensors to track patterns of social interaction in autistic and neurotypical children. These methods for recording large groups of people in real-world settings have excellent potential to uncover differences in social behaviour and open up new avenues for both research and applications.

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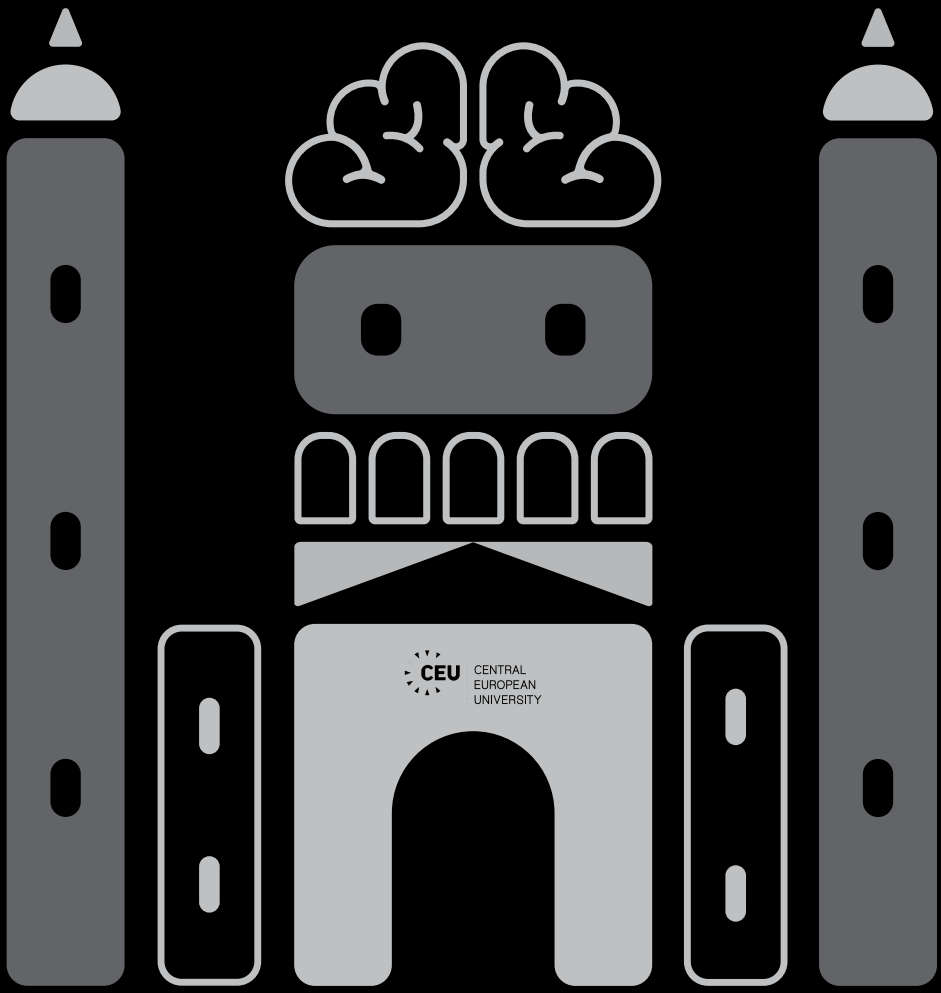

# SYMPOSIA AND PAPER SESSIONS

# SYMPOSIUM 1

## DEVELOPMENTAL BUILDING BLOCKS OF THE LANGUAGE OF THOUGHT

Thursday, 09 January 2025, 13:15-14:30

**Organizers:**

Nicolò Cesana-Arlotti, Yale University, US

Jean-Remy Hochmann, Institut des Sciences Cognitives Marc Jeannerod, France

**Discussant:**

Luca Lorenzo Bonatti, ICREA and Univarsitat Pompeu Fabra, Center for Brain and Cognition, Spain

**Speakers:**

Jean-Remy Hochmann, Institut des Sciences Cognitives Marc Jeannerod

Barbara Pomiechowska, University of Birgmingham

Nicolò Cesana-Arlotti, Yale University



Among all the creatures, we stand out for the capacity for linguistic productivity and for domain-general and flexible forms of learning, planning, and decision-making. To account for all this, influential frameworks in linguistics (Heim&Kratzer, 1998; Chierchia, 2013; Petrsoki, 2018) and the cognitive sciences (TenebaumEtAl.,2011; Icard&Moss, 2014; Goodman et al. 2015) recruit the notion of domain-general cognitive systems that integrate symbolic representations with a variety of logical operations (Fodor, 1975; Quilt-DunnEtAl, 2022). These frameworks pose the existence of a Language of Thought. However, despite its importance for human cognition, the developmental origins of the Language of Thought are unknown. Are language acquisition, extensive experience, or formal education required to have a Language of Thought?

This symposium takes a pluralist approach to this question. Namely, our three talks offer a survey of novel research and findings about the developmental building blocks of the Language of Thought: how and when do critical properties, such as symbolic format, compositionality, and logical cognition, emerge and develop early in life?

The three contributions of this symposium, originating from three different countries and two continents (France, the United Kingdom, and the United States), present novel results investigating how preverbal infants think. Together, these talks span a wide developmental

range (from 7-month-old infants to 4-year-old children) and embrace a great variety of developmental techniques, including eye-tracking, pupillometry, violation of expectation, and force-choice paradigms. Hochmann and Papeo's paper, "Representations of abstract thematic roles in 7-month-old infants", combines habituation and pupillometry to show that preverbal infants can represent the abstract roles agent and patient and to ask whether these representations have symbolic format. The contribution by Pomiechowska and colleagues, titled "Function composition in the crib: human infants productively combine two newly learned functions of a tool", investigates whether 15- month-old infants can learn and combine the two functions of a novel tool, without the scaffolding of explicit language. Finally, Cesana-Arlotti and colleague's talk "Of impossible cupcakes and necessary peppers: preschoolers deploy logical concepts to make sound modal decisions" presents evidence that preschoolers as young as three years can recruit the logical categories of Possibility, Impossibility, and Necessity to help another agent to obtain a benefit or to avoid harm.
The three contributions argue that infants and young children demonstrate compositional thought, representation of abstract thematic roles, and logical understanding of the (im) possible. While all three contributions converge in highlighting the continuity between infants' and children's cognition and adult symbolical, combinatorial, and logical thought, possible discontinuities are also identified and discussed. These issues will be further discussed and put into perspectives by our discussant, Prof. Luca Bonatti.
Altogether, these empirical observations improve our characterization of prelinguistic cognition, asking whether it mirrors critical properties of the adult Language of Thought. The building blocks of higher-order cognition might not entirely depend on language acquisition, pointing at the uncharted complexity of the preverbal mind.



## Representations of abstract thematic roles in 7-month-old infants

**Jean-Remy Hochmann, Liuba Papeo**
CNRS - Institut des Sciences Cognitives Marc Jeannerod, France

A propositional language of thought implies thematic roles such as agent, patient, instrument, defining the relation between components of a proposition. We investigated how 7-month-old infants encode visual scenes involving two people, an agent-like and a patient-like actor, and whether they spontaneously assign actors to abstract agent/patient role categories. Stimuli featured two individuals, with the purported agent (e.g., a male), leaning forward in a dynamic posture, and the purported patient (a female) in a less dynamic or static posture. In Experiment 1, infants habituated to a sequence of up

to twelve images presenting the same two individuals, always in different postures but with consistent role assignment as defined by the posture. After habituation, two types of novel images were shown, in which the same two individuals in two novel postures either kept their previous roles or switched roles. In Experiment 2 (Fig. 1), images of dyads were presented in a pseudo-random order, with consistent role assignment in the majority (83%) of images and deviant in the remaining images (17%). We measured surprise to role switch, in the form of increased looking time in Experiment 1, and pupil dilation in Experiment 2. Finally, since the purpose of the agent and patient thematic roles is to generate a relational structure (i.e., agent acts on patient), we predicted –and verified– that surprise reactions to role switch preferentially happened in a relational context, i.e., when the two individuals in a stimulus faced towards each other, as if interacting, rather away from each other, as if acting independently. Remarkably congruent results from the habitation and pupillometry studies demonstrate that preverbal infants can represent the abstract roles agent and patient, which they automatically assign to actors across very different events, depending on visual cues such as body posture and position.



## Compositionality outside of natural language: infants combine newly learned functions

**Barbara Pomiechowska[1], Ernő Téglás[2], Ágnes Melinda Kovács[2]**

[1]University of Birmingham, UK; [2]Central European University, Austria

The productivity of the human mind is rooted in our ability to flexibly combine concepts and functions, known also as combinatorial thought or compositionality. However, the developmental origins of combinatorial thought remain poorly understood. To tackle this question, we investigated whether 15-month-olds can s learn two distinct functions of a tool and then combine their outcomes. Infants watched a machine that transformed objects. It had two functions (f1-kind change: change the kind of the object that went inside, a➔b; f2-duplication: duplicate the object that went inside, a➔aa). Each function was triggered by a different handle. Experiment 1 established that infants (N = 16) could learn both functions. After being familiarised with both functions, one at a time, infants looked longer at test trials featuring an action-outcome swap (e.g., operating the kind-change manipulandum resulted in a duplication of the input object). Experiment 2 tested whether infants (N = 32) could combine the two functions. In the experimental condition, we used the same familiarization (as in Experiment 1) and a new test, in which both handles were used simultaneously. There were two test outcomes: congruent with function composition

(e.g., duplication + kind change: a→bb), or incongruent, involving the outcome of only one operation (e.g., duplication only: a→aa). Because the congruent outcome was perceptually novel (i.e., a new configuration of objects), we administered a baseline condition to assess the effect of the perceptual novelty. In the baseline condition, infants displayed longer looking to perceptually novel outcome, but this preference reversed in the experimental condition whereby this outcome was congruent with function composition. These results suggest that 15-month-olds readily learn multiple novel functions and productively combine their outcomes. Computational underpinnings of combinatorial thought seem to be in place during the second year of life and do not require the scaffolding of natural language.

## Of impossible cupcakes and necessary peppers: preschoolers deploy logical concepts to make sound modal decisions

**Nicolò Cesana-Arlotti[1], Sofia Jáuregui[2], Peter Mazalik[2], Shaun Nichols[3], Justin Halberda[2]**

[1]Yale University, USA; [2]Johns Hopkins University, USA; [3]Cornell University, USA



Our capacity for rational decisions hinges on judgments of what could, cannot, or has to happen. Yet, the origins of this precious resource are uncertain and at the center of a major controversy in developmental psychology; with many researchers claiming that modal concepts are not available prior to the age of four years (LeahyEtAl.,2022), and that this understanding awaits the acquisition of rich linguistic knowledge (Leahy&Carey,2020). To investigate preschoolers' modal representations, in a novel paradigm, preschoolers (N = 96; age groups: 3-4 years and 4-5 years) are asked to make one-shot decisions between necessary/possible /impossible outcomes to help an agent to obtain a benefit or to avoid harm. We found that both older and younger preschoolers succeed in our tasks by flexibly adapting their choices to both the modal force of the options (necessity/possibility/impossibility) and their valence (benefit/harm). Furthermore, across two experimental designs we found and replicated the result that 3-year-olds succeed in decisions between options that cross logical categories (i.e., necessity vs possibility, possibility vs impossibility) but failed when they were asked to compare probabilities within the same category (i.e., highly probable possibility vs improbable possibility), even when the gaps in probability between options were identical (100%, 66%, 33%, 0%). Crucially, this pattern of success and failure rules out sampling heuristics and probabilistic representation, revealing logical concepts with a categorical character. Altogether, in our experiments, children made sound decisions between necessary, possible, or impossible options. Young preschoolers' pattern of success in our tasks provides critical evidence that the capacity of modal judgment

highlights the categories of necessity and impossibility, distinct from mere probabilities. We discovered that this capacity is not entirely dependent on external linguistic representations (e.g., modal words) and may be an essential property of human thought.

# PAPER SESSION 1

## EXPLORATION AND METACOGNITION

Thursday, 09 January 2025, 16:30-17:30

**Chair:**
Sila Cakmak

### Dogs' expectations about occlusion events: from expectancy violation to exploration

**Christoph Völter[1], Ana Tomasic[2], Laura Nipperdey[3], Ludwig Huber[2]**
[1]Max Planck Institute for Evolutionary Anthropology, Germany; [2]Messerli Research Institute, University of Veterinary Medicine Vienna, Austria; 3University of Leipzig, Germany

Occlusion events are a key feature of the physical world. Expectations about the visibility of objects can help animals track both objects and animate beings. However, previous research has yielded mixed results regarding object permanence in different animal species, including dogs (Canis familiaris). In this study, we conducted two eye-tracking experiments to investigate whether dogs form expectations about (screen-based) occlusion events and whether violations of these expectations elicit increased attention, as evidenced by longer looking times and pupil dilation. Our results show that dogs indeed showed increased attention to events in which objects did not reappear when they should have. We then conducted a third experiment to (i) replicate this expectancy-violation effect in a real-world context and (ii) investigate whether such violations would lead to increased object exploration, similar to findings in human infants. The results showed that dogs not only exhibited prolonged attention to events that violated occlusion principles, but also interacted more with the objects involved in these expectancy-violating events. These findings suggest that non-human animals, such as dogs, may be driven to explore objects that behave unexpectedly, providing them with opportunities to learn about fundamental aspects of their environment.

## Young children deliberately choose not to know things that could hurt their feelings or ruin a surprise

**Tindaya Déniz, Sebastian Grueneisen**
Leipzig University, Germany

Humans are often characterized as tireless seekers of knowledge, with childhood in particular being seen as a period of active exploration, impulsivity, and curiosity (Gopnik, 2020; Liquin & Lombrozo, 2020). However, adults sometimes deliberately avoid seeking information, even when the potential benefits are high, and the cost of acquisition is low – a behavior known as deliberate ignorance (Hertwig & Engel, 2016). How does deliberate ignorance first emerge in young children and what motivates this behavior? To address this question, we conducted a vignette study in which 5-8-year-old children (N = 80) were presented with eight hypothetical scenarios tapping into four potential motives for deliberate ignorance: emotional regulation, maximizing suspense and surprise, strategic self-interest, and ensuring impartiality and fairness. In addition, each child completed a cognitive test battery assessing inhibitory control, meta-ignorance, and anticipated regret as potential predictors of deliberate ignorance. The results show that deliberate ignorance significantly increased with age but this age effect was qualified by an interaction with motivation. Five-year-olds only occasionally chose to remain ignorant, with 30% choosing to know in all cases. In older children, there was a steep increase in deliberate ignorance to maximize suspense and regulate emotions (e.g., avoiding finding out about premature birthday gift reveals or missed fun due to sickness). Hardly any children remained ignorant for strategic reasons or to remain impartial. Cognitive predictors did not significantly predict children's tendency to remain ignorant. Transcribed justifications revealed that, in more than half of the cases, children provided an explanation consistent with our predicted motive for ignorance. These results indicate that deliberate ignorance occurs as early as preschool age, but that children show a clear pattern of wanting to know in a largely indiscriminate manner to willfully avoiding certain information, mostly to spare their own feelings or to preserve a surprise effect.

## How reflecting on their own uncertainty shapes children's investigation of surprising claims

**Tone Kristine Hermansen[1], Kamilla Flem Mathisen[1], Samuel Ronfard[2]**

[1]University of Oslo, Nprway; [2]University of Toronto, Canada

Hearing a surprising claim prompts young children to explore. However, because their exploration increases and changes as they grow older—becoming more targeted and efficient—we ask: what underlies this development? To answer this question, we tested whether children's ability to reflect on the cause of their uncertainty about a surprising claim helps them investigate that claim more effectively, and if this ability improves with age. We assigned 4-7-year-olds (N= 174, Mage=68.77 months, 52.87% girls) to either a prompted or an unprompted condition. In each condition, children heard a surprising claim before they were asked whether they thought the claim was true or not, how (un)certain they were, and how they could determine the veracity of the claim. In the prompted condition, children were also asked why they were (un)certain. The analyses showed that prompting children to explain their beliefs did not affect their inclination to efficiently test the claim. However, those who were able to provide a plausible reason for their uncertainty more often suggested an efficient test for that claim—controlling for their ability to identify one when given multiple options. By ruling out the possibility that age related differences in the type of empirical test suggested by older children does not simply reflect age-related differences in children's knowledge of how to test a claim, the current study provides strong support for the notion that developments in children's reasoning about their beliefs drive changes in their empirical evaluation of those beliefs. That is, having the skills to reason scientifically is not sufficient to prompt children to follow up on their skepticism efficiently, they must also understand the cause of their skepticism.

# PAPER SESSION 2

## SOCIAL COGNITION

Friday, 10 January 2025, 11:15-12:15

**Chair:**
Anna Kispál

### Triggers of corrective behavior in young children

**Avi Benozio, Lena Kabha**
The Hebrew University of Jerusalem, Israel



Pro-social behavior is shaped by a mix of personal factors, such as prior prosocial acts of others, friendship status, or perceived neediness, and societal influences like norms of fairness (Grueneisen & Warneken, 2022; Ulber et al., 2017). This study explores the emergence of 'corrective behavior' within reciprocal contexts, investigating what types of information prompt young children to recognize and rectify a failed reciprocal interaction. The sample included 203 5-year-olds (Mage=5.6; 50% boys), and employed a one-shot, costly, sequential reciprocal task adapted from Benozio et al. (2024). Initially, children received egalitarian distributive choices from an unidentified, age- and gender-matched partner. In response, participants could choose either an in-kind egalitarian distribution or a selfish one. Afterward, the partner's identity was revealed, accompanied by one of the following verbal cues: two individualistic cues ("Hi, I'm Dan" and "I was nice to you earlier"), two normative cues ("fairness is important" and "fairness is NOT important"), and a future encounter cue ("I'll be joining your kindergarten soon"). Participants then had the opportunity to maintain or change their initial response. Results indicated that although children initially evaluated the partner's egalitarian behavior positively, over 70% made selfish, rather than reciprocal, responses toward unidentified partners. However, McNemar tests showed significant shifts from selfish to egalitarian responses when the partner highlighted prior behavior ($\chi^2(1)=12.9$, $p<.001$), emphasized fairness ($\chi^2(1)=6.27$, $p<.05$), or noted a future interactions ($\chi^2(1)=7.39$, $p<.05$). Additionally, girls were found to be more responsive to normative cues, being four times more likely than boys to change their decision from selfish to egalitarian ($\chi^2(1)=3.7$, $p<.01$). These findings suggest that 'corrective behavior' in reciprocal contexts is not only influenced by reminders of prior actions or social norms but can also be spontaneously enhanced when future interactions are anticipated.

## Drivers of accent bias in children: A cross-cultural and cross-linguistic study

**Ajna Kertész[1], Ildikó Király[2], Catharine Echols[1]**

[1]The University of Texas at Austin, USA; [2]ELTE Faculty of Education and Psychology, Hungary

Both adults and children show accent-related biases that tend to favor native speakers over foreign-accented speakers (Hanzlíková & Skarnitzl, 2017; Kinzler et al., 2009). These biases are often attributed to social group preferences (Kinzler et al., 2011). Another less explored explanation is that the cognitive difficulty of processing accented speech leads to negative affect, which then results in negative social judgments (Lev-Ari & Keysar, 2010). However, drivers of accent bias may vary based on cultural and linguistic context. To investigate this, we designed a study that measures accented speech processing as well as the social judgments directed towards accented speakers in the U.S. with English-speakers and in Hungary with Hungarian-speakers. In both countries 4-6-year-old children (N=70) complete a two-part 10–15-minute task on PsychoPy. (1) word categorization task measuring processing speed and accuracy, (2) a social judgments section involving evaluations of speakers on trustworthiness, intelligence and likeability. Stimuli consist of three different accents: in the US, Standard American English (US), New Zealand English (NZ) and Turkish-accented English (TR); in Hungary, Standard Hungarian (HU), Russian-accented Hungarian (RU) and American English-accented Hungarian (AE). All words and passages are counterbalanced and matched for duration and sound intensity. In the US sample children took longer ($\beta = 0.80$, SE = 0.30, $p = .008$) and made more mistakes ($\beta = -0.19$, SE = 0.03, $p < .001$) when processing foreign-accented than native-accented speech. Moreover, higher accuracy in processing predicted rating the speaker as nicer ($\beta = .04$, SE = .02, $p = .036$) and more trustworthy ($\beta = .35$, SE = .11, $p = .003$). Data collection is in progress in Hungary and predicted to be completed by December 2024. Overall, these preliminary results suggest that processing accented speech is cognitively taxing and this difficulty may at least partially explain social biases against foreign-accented people.



## Focused or overstimulated? Children with greater physical and visual engagement do not learn more

**Sarah Shepherd, Maria Castaneda, Celeste Kidd**

University of California, Berkeley, USA

We investigate how children learn from screens that are either visually complex or simple, and whether visual and physical engagement predicts their learning. We find that the ability

to visually and physically disengage both predict learning. We presented 55 3- to 6-year-old children with novel word-object pairings overlaid on a visually complex or visually simple display. Children watching the visually complex stimuli fidgeted significantly less and visually fixated more than children in the visually simple condition. However, despite higher rates of physical and visual engagement, these children did not learn more word-object pairings. Crucially, sustained visual attention predicted learning deficits in the visually complex condition. Decreased fidgeting in the complex condition may indicate overstimulation, making children appear highly focused while actually impairing their ability to disengage and ultimately disrupting learning. This finding is in line with previous work showing that children learn better from visual media from which they look away more often (Shepherd & Kidd, 2024). This work has important implications for understanding what types of media disrupt children's learning and pose a risk to healthy development. Fast-paced and fantastical television impairs executive functioning and disrupts healthy attention in young children (Anderson et al., 1977; Geist & Gibson, 2000; Essex et al., 2022; Lillard & Peterson, 2011). More generally, children's screen use predicts developmental delays, worse academic performance, and disordered attention, among other adverse effects (Madigan et al., 2019; Lissak, 2018). Overstimulating properties of popular media content likely contribute to these adverse outcomes (Christakis, 2018). The visually salient stimuli in our complex condition depicted colorful, naturalistic scenes, which are notably less perceptually captivating than popular children's edutainment content, but still elicited potentially unhealthy over-engagement and disrupted learning. Mistaking overstimulation for enjoyment or focus risks promoting content that may actually be detrimental to learning, especially for young children.

# SYMPOSIUM 2

## COMPARING CURIOSITY: CHANGES IN INFORMATION-SEEKING ACROSS DEVELOPMENT AND EVOLUTION

Friday, 10 January 2025, 13:15-14:30

**Organizer:**
Laura Lewis, University of California, Berkeley, US
Francesco Poli, University of Cambridge, UK

**Speakers:**
Victor Ajuwon, University of Cambridge
Francesco Poli, University of Cambridge
Laura Lewis, University of California, Berkeley



Curiosity, or the drive to gain information, is critical to learning and innovation and enables the efficient exploration of the environment (Kidd & Hayden, 2015). Curiosity has deep phylogenetic roots, with rudimentary forms even found in roundworms (Calhoun et al., 2014). Similarly, simple mechanisms supporting curious behavior seem to be present from very early in infancy, and increase in complexity across the lifespan. Both across species and development, curiosity fulfills the key role of allowing an individual to reduce uncertainty, thereby improving predictions about their physical and social environments and gaining increased control over them (Forss et al., 2024). Although the field of research on curiosity in humans and other animals has recently blossomed, there is still much to discover about how mechanisms of curiosity develop in humans and have evolved across phylogeny. Here we propose a unifying symposium that brings together scientists from diverse backgrounds who are conducting cutting-edge research in humans and other animals to reveal the ontogenetic and phylogenetic patterns of the underlying cognitive mechanisms that drive curiosity.

Speakers are driven by questions regarding the phylogenetic and developmental continuity of cognitive mechanisms of curiosity. Their research tackles questions such as “Do similar mechanisms of curiosity exist across species? Which selective and developmental pressures shape mechanisms of information-seeking? Do meta-cognition and meta-learning, which underlie mechanisms of curiosity, increase across evolution and ontogeny?”

First, Dr. Ajuwon shows the unique information-seeking skills possessed by goldfish. In

contrast to other vertebrates, in goldfish the 'savoring' effect for positive outcomes is not stronger than the aversive 'dreading' related to the failure to receive reward. This led goldfish to display a lack of preference for informative cues, even if they were successful in discriminating cue informativity. Moving from evolutionary to developmental differences, Dr. Poli presents work on infants and toddlers demonstrating the developmental mechanisms that allow infants to move from a preliminary epistemic grazing context through epistemic foraging, and finally to epistemic farming later in childhood. Next, Dr. Lewis shows that both chimpanzees and children are socially curious, and have differing drives for social information gain that vary with life history characteristics. Young children and male chimpanzees are willing to forgo a physical reward in order to gain social information, and boys become more curious about negative social interactions whereas girls become more curious about positive social interactions across development. Finally, Professor Forss will discuss how this body of research, driven by similar questions regarding the mechanisms of curiosity but studied in a wide variety of species and developmental timepoints, expands our shared understanding of these mechanisms.

Collectively, we provide a comprehensive view of the phylogenetic and developmental pressures that shape mechanisms of curiosity across a diverse set of species and ages (from goldfish to apes, from infancy to adulthood). By including three speakers and an expert discussant, we hope to find areas of both mutual understanding and perhaps disagreement in order to build an enriching discussion that will foster new connections, collaborations, and research programs.



## To know or not to know? Exploring subjective information value in a teleost fish

**Victor Ajuwon[1], Tiago Monteiro[2], Mark Walton[3], Alex Kacelnik[3]**

[1]University of Cambridge, UK; [2]University of Veterinary Medicine Vienna, Austria; [3]University of Oxford, UK

Like humans, a range of mammalian and avian species tested so far, prefer foretold over unsignalled future events, even if the information is costly and confers no direct benefit, highlighting that a range of animal species may possess flexible, curiosity-driven behaviour. However, it is unclear whether these preferences are an epiphenomenon of ubiquitous mechanisms of reinforcement learning, or whether they reflect derived information-seeking mechanisms evolved to reduce uncertainty. We investigated whether a teleost fish that shares basic reinforcement learning mechanisms with birds and mammals also presents such preference, with the aim of dissociating secondary reinforcement from

learning involving sensitivity to uncertainty. Goldfish chose between two alternatives, both yielding a 50% chance of reward 5s after being chosen. The 'informative' alternative caused immediate onset of either of two stimuli (S+ or S-) correlated with the trial's forthcoming outcome (reward/no reward), but subjects could not exploit the information to increase their reward rate. Choosing the 'non-informative' option, instead triggered either of two uncorrelated stimuli (N1 or N2). Goldfish learned to discriminate between the different contingencies, but did not develop preference for the informative option. This shows that the ability to learn through secondary reinforcement is not sufficient to generate informative preferences in goldfish, and the difference with birds and mammals supports the hypothesis that information-seeking, rather than simple conditioning, causes the paradoxical preference for unusable information shown by the latter.

## Developmental change in curiosity: Epistemic grazing, foraging and farming

**Francesco Poli**
University of Cambridge, UK



Curiosity is a drive for information and its simplest form, habituation, is observed even in foetuses. Although this rudimentary form of curiosity is present from the beginning of life, it consists of feeding on readily available information without actively searching for it, a process I define as epistemic grazing. The mechanisms that support curiosity change across development and become increasingly more complex. My talk will focus on two key developmental changes. First, curiosity transitions from reactive to active: Instead of simply disengaging from existing stimuli, infants start seeking information actively. This process has been termed epistemic foraging (Andersen & Kiverstein, 2024). I will outline how epistemic foraging is the result of two concurrent developmental processes. Specifically, across three studies, I will show that (1) infants gradually learn that information is valuable, and (2) they gradually improve in controlling their attention. Consequently, (3) they become increasingly able to flexibly engage and disengage from a stimulus depending on its information content. The second key developmental change is a further advancement in how children seek information. Instead of foraging for information, they start epistemic farming: they spend time and effort to build environments that allow them to learn more and faster. To investigate the emergence of this ability, we designed three toys that allow children to perform known actions to discover novel visual or auditory effects. Crucially however, the toys can also be used in completely new ways that go beyond the given

instructions. By examining 3-year-olds' free exploration patterns during play, we show how they balance epistemic foraging and epistemic farming to strategically maximize their learning. These results allow us to trace the developmental changes in human curiosity from epistemic grazing to farming, and could drive new comparative research to test how ontogenetic and phylogenetic differences shape curiosity across species and individuals.

## Social and cultural curiosity in chimpanzees and children

**Laura Lewis[1], Oded Ritov[1], Rachna Reddy[2], Esther Herrmann[3], Alejandro Sanchez-Amaro[4], Alison Gopnik[1], Jan Engelmann[1]**

[1]University of California, Berkeley, USA; [2]University of Utah, USA; [3]University of Portsmouth, UK; [4]University of Stirling, UK



Curiosity, the drive to gain information, has been studied extensively in physical and ecological domains, yet is rarely studied in social and cultural domains. Humans and chimpanzees are deeply sociocultural species that depend on unique social relationships and cultural practices for survival and wellbeing. These cultures share similarities and evolutionary roots, and are defined by variants that are passed on through cultural transmission. Chimpanzees and humans also have complex relationships with outgroup individuals with different cultural norms, and intergroup encounters can range from prosocial and positive to physically violent and even lethal. It is likely adaptive to be curious about the practices of one's own culture, to gain salient cultural information that will promote the integration of an individual within their community. It may also be evolutionarily important to be curious about unfamiliar cultures to gain information about potential mates, rivals, and opportunities for territorial expansion. Therefore, we developed comparative studies with children and chimpanzees to explore the evolution and development of social and cultural curiosity, defined as the drive to gain information about others and their cultural traditions. We found that children (4 - 6 years old, N = 94) and adult chimpanzees (N = 27) are socially curious, and are more willing to gain information about social interactions than about an individual acting alone. Boys also become more curious about negative social interactions whereas girls become more curious about positive social interactions as they develop. Data collection is completed and analyses are ongoing to determine whether children (4 - 12 years old, N = 135) demonstrate biased cultural curiosity. Combined, these results indicate that chimpanzees and children are socially curious, and that it may be advantageous for particular groups of individuals to gain some types of social information over others, depending on life history and cultural identities.

# PAPER SESSION 3

## WORD LEARNING

Friday, 10 January 2025, 16:30-17:30

**Chair:** Eszter Körtvélyesi

### Word learning under uncertainty in young children and adults

**Natalie Bleijlevens, Tanya Behne**
University of Göttingen, Germany

When learning novel words, referential ambiguity is a constant part of children's learning environment. Despite facing this objective uncertainty, children seem to infer the referents of novel words with relative ease. Here, we report the results from three studies that investigated the role of children's inferential, social-pragmatic, and metacognitive skills in their word learning under uncertainty. In study 1, we assessed the inferential decision processes leading to 2-3-year-olds' (n=75) and adults' (n=112) success in the Mutual Exclusivity task (i.e., the mapping of novel labels to unfamiliar rather than familiar referents; Lewis et al., 2020). Neither age group disambiguated by directly mapping novel labels to their referents based on relative object novelty. Instead, they used reasoning-by-exclusion strategies, building on their pragmatic and lexical knowledge, to disambiguate novel words and retain them after a delay (Bleijlevens & Behne, 2024). In study 2, we tested 2-3-year-olds' (n=72) and adults' (n=112) ability to use their social-pragmatic understanding to resolve referential ambiguity in the absence of lexical information. Participants successfully inferred the correct referents of novel words by interpreting the common ground with the speaker (here: discourse novelty). Their behavior could not be reduced to effects of object novelty alone, and it led to long-term learning success (Bleijlevens et al., 2023). In study 3, we assessed 4-5-year-olds' (n=82) and adults' (n=70) ability to monitor their own uncertainty (implicitly and explicitly) during different levels of referential ambiguity, and to make use of this information in the word learning process. With increasing referential ambiguity, participants' explicit uncertainty systematically increased and children spontaneously sought more information. For adults (but not children), high levels of ambiguity during learning increased their willingness to update these word-object-links subsequently. Taken together, the results contribute to ongoing discussions about the mechanisms and mental processes that enable children to learn words from ambiguous contexts.

## No evidence of curiosity-driven information selection advantage for infants' novel word learning

**Marina Bazhydai, Malcolm K.Y. Wong, Elena Constanze Altmann, Gert Westermann**
Lancaster University, UK

Research has demonstrated that having control over informational input enhances attention and memory and leads to faster and more robust learning, in adults and older children (e.g., Gureckis & Markant, 2012). However, emerging evidence from early childhood has produced inconclusive results (Ackermann et al., 2020; Fandakova & Gruber, 2020; Pereira et al., 2014; Partridge et al., 2015; Ruggeri et al., 2019; Zettersten & Saffran, 2020). Specifically, it remains unknown whether enabling infants to actively control their learning process leads to better retention of novel labels. The current study investigated 20-23-month-old infants' (N = 75) curiosity-driven information selection in a novel word learning task, designed to identify any potential advantage for active learning over passive learning. The experimental paradigm capitalized on infants' gaze rather than manual actions as an expression of curiosity, using saccadic eye movements as visual information sampling. In a gaze-contingent eye-tracking paradigm, infants in one (Curiosity) condition were given the opportunity to structure their own information seeking to actively create word learning opportunities for themselves, while infants in two other conditions (Yoked and Random) engaged in learning novel words passively. Infants' learning of word-object associations (baseline-corrected proportion of cumulative looking time to the target object at test) was compared across active and passive learning paradigms. Contrary to the hypothesis, the results indicate no advantage of active information selection on retention of novel words above and beyond passive learning ($F(2, 72) = 0.11$, $p = .900$, $BF_{01} = 8.065$,), with infants across all conditions retaining novel words above chance, emphasizing the resilience of infant learning mechanisms (ps <.05). This study provides a crucial insight advancing our understanding of early word learning, demonstrating the resilience of infant word learning mechanisms, and warrants further investigations of the role of curiosity in different learning contexts and with more fine-grained research questions.

## Investigating heterogeneity in shape bias: a study on procedural, stimuli, and age-related variations

**Samah Abdelrahim, Sadio Abdi, Meesha Ryan, Michael Frank**

Stanford University, USA

The “shape bias” – the tendency to generalize new nouns by shape rather than other features like color or texture – has been argued to facilitate early noun learning for children. However, evidence regarding the magnitude and nature of this bias, as well as its developmental trajectory, is conflicting. A recent meta-analysis of the shape bias (Abdelrahim & Frank, 2024) found that more than 90% of the variance is due to within- and between-study heterogeneity. We hypothesize that this heterogeneity arises from procedural variations, including differences in stimuli, contrasted properties (e.g., material, color, function), the number of test trials, and task types (e.g., forced-choice, non-forced-choice, endorsement). This work aims to develop a standardized set of stimuli that can be used across various tasks, including both forced-choice and non-forced-choice, as well as perceptual (shape-material) and conceptual (shape-function) word generalization tasks. In an initial set of 7 trials with 20 (target of 24) children aged 2-5 years, we observed a developmental shift from a material bias at age 2 to a shape bias in older children. A linear mixed-effects model, accounting for random effects of participants and stimuli, revealed a significant effect of age (estimate = 0.011, SE = 0.0028, t = 4.008). However, the small sample size per age group and the exclusion of dimensions like “color” limit the interpretability of these findings. Ongoing research will increase the sample size and include additional dimensions, such as function vs. shape, in both forced-choice and non-forced-choice tasks. The ultimate goal is to quantify how much variance is explained by different procedural designs and stimuli across a broader age range and sample size.

# SYMPOSIUM 3

## PRAGMATIC MODELS OF EARLY COMMUNICATION: FACING THE DEVELOPMENTAL CHALLENGE

Friday, 10 January 2025, 17:45-19:00

**Organizer:**

Edoardo Vaccargiu, University of Neuchâtel

**Speakers:**

Nima Mussavifard, Humboldt University of Berlin
Edoardo Vaccargiu, University of Neuchâtel
Antonio Scarafone, University of the Basque Country

**Discussant:**

Nausicaa Pouscoulous, University College London



Empirical evidence collected over the last two decades has shown that infants are immersed in communication right from the outset and can interpret communicative episodes in a contextually appropriate manner (Matthews, 2014). In particular, sensitivity to "ostensive signals" bootstraps young infants' communicative competence (Csibra, 2010), and scaffolds their progression to gestural communication before language onset (Bohn & Frank, 2019). The ostensive dimension of human communication is linked to the Gricean notion of "communicative intention" (Grice, 1957, Sperber & Wilson, 1986), which is traditionally characterized as an intention having other intentions and beliefs as its content, and thus relies on complex meta-representations (Sperber, 2000). This traditional account faces a long-standing developmental challenge: there seems to be no independent evidence that young children can act with, and attribute such complex intentional states; therefore, the cognitive reality of "communicative intentions" remains an open question. In recent years, pragmatic models have tackled this challenge from different standpoints, by reducing the cognitive requirements for Gricean communication (Moore, 2017), rethinking ostensive communication non-mentalistically (Sperber & Wilson, 2024), or privileging a socio-normative perspective that shifts the cognitive burden of communication onto features of the interaction (Geurts, 2019). In this symposium, we orchestrate a dialogue among three different ways of thinking about early communication to address the developmental

challenge in light of experimental data.

The first contribution puts forth a minimal alternative to Griceanism that considers attributed intentions as cognitively insufficient for understanding communication. In this view, children's pragmatic inferences are licensed by a concept of communicative action that targets "representational action", i.e. the manipulation of entities transmitting detached and open-ended content. By detecting ostensive markers, children could recognize representational communication and form the content placeholder that they may fill in based on the presented evidence. The second contribution provides a novel post-Gricean perspective that grounds early pragmatics on two fundamental pillars: the ostensive and the inferential pillars. While the latter can be viewed as a mentalistic inference guided by relevance expectations, the former can be underpinned by implicit "sensorimotor representations" that dispense with mentalization. This view offers a unitary framework for interpreting data from infant pragmatics, while additionally explaining the cognitive underpinnings of some sophisticated communicative skills in later pragmatic development. The third contribution proposes to move from a psychological perspective to a socio-normative one. In communicating linguistically, adults negotiate commitments. In communicating prelinguistically, children prepare themselves to do so. Some of the behavioral dispositions manifested by children are normative. This explains children's communicative successes as well as failures and accounts for how they can learn through communicating. In this view, communicative intentions have no explanatory role to play. Collectively, this symposium aims to offer a venue for discussing a timely topic for pragmatic theories that intertwine different developmental, cognitive, and philosophical perspectives. Our discussant, Prof. Nausicaa Pouscoulous, will introduce the open discussion by providing an integrative synthesis and commenting on the presented contributions in light of her renowned expertise on children's pragmatic development.



## The developmental foundations of open-ended communication

**Nima Mussavifard**
Humboldt University of Berlin, Germany

Open-ended communication is a human-specific ability, and a critical question in understanding cognitive development is how this communication system emerges during ontogeny. Influenced by Grice (1957), the prevailing approach posits that human communication involves the expression and attribution of communicative intentions, framing

communication as an exercise in mindreading. However, the limited mindreading capacities of already communicative infants casts doubt on the plausibility of this Gricean perspective. In this talk, I challenge the assumption that higher-order mentalistic representations are necessary or sufficient for explaining the development of open-ended communication. These representations are not necessary, in part, because communicative episodes can often be identified through the detection of coded ostensive signals (e.g., eye contact and infant-directed prosody) that accompany communication. More critically, mindreading alone does not sufficiently account for the interpretation of communicative acts. Mindreading is useful primarily because it augments the process of action understanding, relying on a concept of instrumental action that interprets environmental changes as the agent's goal. However, communication typically brings about no observable change to the physical environment. Drawing on these observations, I propose that human communication is grounded in an evolutionarily unique concept of 'representational action'. In communication, external entities are utilized as representational devices that convey content detached from those entities. Communicators manipulate these entities to transmit representational contents, and receivers must infer the represented based on the presented evidence. Sometimes (e.g., in spoken language), the representational nature of entities is evident. However, ostensive signals can actively mark entities as representational, thereby triggering the communicative concept. If correct, this theory (like Griceanism) can account for both the recognition and interpretation of communicative episodes in infancy. Yet, it diverges by proposing that neither process necessitates complex mindreading; instead, it requires only a representation of external representations, which may be triggered by ostensive markers.



## Redescribing early pragmatics

**Edoardo Vaccargiu, Diana Mazzarella**
University of Neuchâtel, Switzerland

According to the Gricean view, human communication involves expressing and inferring communicative intentions, which require complex mentalization (Grice, 1989; Sperber & Wilson, 1995). This raises the question of whether the Gricean framework can be reasonably applied to infant communication. Although some minimalist analyses of early communication have been proposed (Breheny, 2006; Moore, 2017), they have overlooked the issue of how basic communication evolves into more sophisticated forms during cognitive development. In this work, we propose a novel (post-)Gricean model of early pragmatics to explain the development of increasingly advanced pragmatic skills throughout ontogeny. Our core

hypothesis is that pragmatic development is driven by a process of 'representational redescription' (Karmiloff-Smith, 1992), wherein implicit knowledge in the infant mind gradually becomes more explicit, flexible, and manipulable. We build on Karmiloff-Smith's (1992) idea that cognitive development begins with 'attention biases' toward external stimuli and domain-specific procedures to process these stimuli. We propose that early pragmatics is underpinned by two fundamental pillars: the ostensive pillar, which relies on in-built assumptions about the communicative function of ostension, and the inferential pillar, which involves relevance expectations that guide pragmatic inference. Infants are naturally inclined to recognize communicative stimuli and interpret them as meaningful and relevant. We argue that as minimal representations in infancy undergo redescription, the ostensive pillar evolves from basic recognition of communicative signals via sensorimotor representations to a more explicit understanding of communicative intent. Similarly, the inferential pillar develops from a simple expectation of relevance to the ability to engage in complex inferential reasoning, including understanding humor or deception. Thus, pragmatic development is not just the accumulation of communicative experiences but a transformation in how implicit communicative knowledge is represented and accessed, enabling greater flexibility and sophistication in communication.



## I don't know what I'm doing! A socio-normative perspective on child communication

**Antonio Scarafone**
Universidad del País Vasco (UPV/EHU), Spain

Much pragmatics is individualistic, being predicated on the notion of pre-formed mental states which are intentionally clued by the speaker and inferred by the hearer (Sperber & Wilson 1995). This approach faces non-trivial difficulties, as it needs to explain how children can reason about propositional attitudes (intentions, beliefs, ...) before being competent users of speech acts (promises, assertions, ...). A plausible alternative is to see communication as a primarily social phenomenon (e.g., Enfield 2017). By granting requests and accepting promises, individuals negotiate normative statuses, chiefly commitments and entitlements (e.g., Geurts 2019), something which enables powerful forms of action coordination. In communicating prelinguistically, infants become increasingly more prepared to share commitments with others, and to regulate their behaviour and expectations accordingly. There are identifiable preconditions for sharing commitments: being able to signal acceptance and rejection, being a minimally competent participant in a variety of

joint activities, and being disposed to behave normatively toward others. 18-month-old infants tick these boxes, so they are minimally prepared to share commitments (contra, e.g., Tomasello 2018). In an important sense, commitments can be shared unknowingly or unwittingly, and they still have the potential to regulate interactions. In this sense, mentalistic reasoning is not a prerequisite for effective communication. To illustrate this point, I will discuss an experiment by Grosse and colleagues (2010), often held as prime evidence that infants are 'Gricean communicators'. I will show that the results are more profitably interpreted in terms of commitment sharing, and that this interpretation makes the notion of communicative intention redundant. Infants do not need to know what they are doing before having become good at it. Rather, having learned to regulate their own behaviour and expectations according to what is said, allows them to reason about what people plan to do and why, namely, intentions and beliefs.

# PAPER SESSION 4

## ACTION

Saturday, 11 January 2025, 11:15-12:15

**Chair:**
Bartúg Celik

### The theory and reality mismatch in developmental robotics: What do robots miss?

**Ezgi Ozgan, Jedediah W.P. Allen**
Bilkent University, Turkey



Action-based perspectives in cognitive science have significantly influenced our understanding of human cognitive development (Allen & Bickhard, 2013). This viewpoint assumes that action is constitutive of cognition and has implications beyond developmental psychology. For instance, the exploration and sensorimotor learning mechanisms proposed by Piaget (1954) have been employed in humanoid developmental robotics (Oudeyer et al., 2007; Vernon et al., 2007, 2016). Recent computational advances, combined with these developmental design principles, have undoubtedly improved robots' motor planning capabilities. However, robot abilities still fall short of the high-level cognition (e.g., representation, reflection, meta-learning) that must follow as a natural progression from an action-based foundation (e.g., the sensorimotor stage). This project explores the gap between this natural progression and the current realities in developmental robotics. The central claim is that roboticists' current perspective should consider the process-oriented nature of developing systems. Although developmental robots effectively employ learning as a process involving adaptive changes based on experience, this process-oriented view is not applied to the whole of the system. In contrast to the dualistic structure of existing robots (i.e., a non-process pseudo-system with a process-like simulation of learning), true development is inherently a characteristic of thermodynamically open systems. The emergent behavior is not just an internal process but one that continuously interacts with other (external or internal) processes, given that the system developing the behavior is itself an organization composed of many interrelated processes. The Interactivist framework is an action-based perspective on cognitive development that considers the interaction of

processes as a broader ontology for all systems, including those that develop (Bickhard, 2006, 2009). The minimal criteria for systems capable of cognitive development will be defined per interactivism and its normative implications to address what is missing from developmental robotics to attain high-level cognition.

## Children's developing evaluations of efficiency

**Claudia Sehl, Stephanie Denison, Ori Friedman**
University of Waterloo, Canada



Infants and children anticipate that agents will act rationally in pursuit of goals. For instance, six-month-olds in habituation studies look longer when agents take indirect paths to goals than direct ones (e.g., Gergely & Csibra, 2003; Liu & Spelke, 2017), and 4- to 5-year-olds explicitly predict agents will take straight paths to goals (Gönul & Paulus, 2021). However, reasoning about efficiency is not always this straightforward—-the efficiency of paths depends on their length, the presence of constraints, and locations of goals. Furthermore, efficient paths are not always better (e.g., Chu & Schulz, 2023). We examined the nuances of children's reasoning about efficiency in three experiments. Three- to seven-year-olds (N=380) saw vignettes where two agents reached goals using either an efficient or inefficient path, and children evaluated which agent did better. Across experiments, efficiency of paths was determined by the aforementioned factors. Experiment 1 showed that 3-4-year-olds only used path efficiency when judging who did better, but not when judging who had more fun (Fig 1). Experiment 2 showed that around 4 years, children judged agents were better when they took straight paths rather than winding ones. But it was only by age 7 that children judged agents did better when they took winding paths with constraints than winding paths without constraints (Fig 2). Experiment 3 showed that around age 5, children showed a sensitivity to efficiency in multi-goal vignettes. Five-year-olds also judged agents did better when they reached goals closest to them, over agents who took identical paths but forwent closer goals (Fig 3). In sum, contrary to what previous work might suggest, we show that children's ability to reason about efficiency is developing across 3 to 7 years. We will discuss implications for theoretical frameworks about rational action and reward-cost tradeoffs.

# Motor capacities and concurrent motor interference influence 12-month-olds' processing of others' goal-directed actions

**Áine Ní Choisdealbha[1], Andrew N Meltzoff[2]**

[1]University College Dublin, Ireland; [2]Institute of Learning and Brain Sciences, University of Washington, USA

Inferring the goals of other people's actions is an important aspect of early social-cognitive development. Relations between motor development and action perception have been demonstrated multiple times in the literature, particularly in relation to grasping where infants who can perform precision grips perceive others' grasping actions differently than same-aged peers who are motorically less advanced (e.g., Daum et al., 2011; Loucks and Sommerville, 2012). Motor skills can be used as a proxy measure of whether an infant has access to a motor representation of a given action. In this study, we designed an experimental intervention that selectively inhibited infants' access to motor representations, using an approach from adult research (e.g. Craighero & Zorzi, 2012). In a random-assignment, counterbalanced, within-subjects design, 48 12-month-olds infants watched reaching and grasping actions with their hands free, and also with their thumb tethered to their index finger to prevent formation of a precision grip (motor interference). Infants' looking times were measured as an adult reached towards a large and small object, using either a power or precision grip. One object was therefore congruent with the actor's grip; the other was incongruent. Results showed an interaction between infants' hand posture and object congruence ($p=0.031$), explained by a drop in percentage looking time to the congruent object under motor interference. There was also an interaction ($p=0.005$) between infant hand posture, object congruence, the adult action type (power/precision grip), and parent-reported fine motor skill (Early Motor Questionnaire, Smith & Libertus, 2022). What this interaction showed is that the effect of motor interference on looking to the congruent versus incongruent objects was more pronounced in the precision grip trials for infants whose fine motor skills were more developed. These results show the joint role of motor experience and motor processes during 12-month-olds' action perception, with implications for developmental theory.

# SYMPOSIUM 4

## NEW INSIGHTS IN INFANT NEUROSCIENCE

Saturday, 11 January 2025, 13:15-14:30

**Organizer:**
Moritz Köster, University of Regensburg

**Speakers:**
Rhodri Cusack, Trinity Collage Dublin
Giulia Orioli, University of Birmingham
Marlena Baldauf, University of Regensburg

**Discussant:**
Stefanie Hoehl, University of Vienna



Infant neuroscience has experienced exciting progress over the past decade, driven by increasingly sophisticated methodologies that enhance our understanding of the developing human mind. This symposium offers an overview of cutting-edge advancements in the field, with a focus on object categorization processes, the application of novel neuroimaging techniques, and resonance phenomena in the infant brain. The symposium concludes with a discussion placing these recent breakthroughs in the broader context of this rapidly developing field.

In the first talk, Cusack et al. present novel findings on the innate and learned components of object vision in early infancy using awake fMRI. Through an impressive dataset from a large cohort (N=133 at 2 months and N=65 at 9 months), the study demonstrates that even at 2 months of age, infants possess rich visual categories. These categories, driven by both innate templates and experience-based learning, propagate from higher visual regions to earlier ones as development progresses. The findings challenge existing views of early visual processing and provide valuable insights into the interplay between innate predispositions and experience-driven learning.

Orioli et al., in the second talk, introduce a groundbreaking method for investigating the infant brain—magnetoencephalography with optically-pumped magnetometers (OPM-MEG). They describe one of the first OPM-MEG infant setups and share preliminary findings from auditory oddball tasks involving 2-month-olds. This new method combines high

spatial and temporal resolution, offering an unparalleled opportunity to examine the dynamic activity of the infant brain. Their results provide the first-ever characterization of OPM-recorded responses in infants, setting the stage for a new era in infant neuroimaging. In the third talk, Baldauf et al. explore resonance phenomena in the developing brain by extending adult research on neural oscillations to infants. Using EEG, they investigated brain responses to rhythmic visual stimulation in 7-to-9-month-old infants, finding resonance as well as a perceptual echo at the 4Hz theta frequency — an oscillation critical for infant information processing. This contrasts with adults, where alpha resonance is typically found in the 10Hz alpha frequency. These results underscore the functional significance of the theta rhythm in early brin development.

Finally, the discussant, Hoehl, synthesizes these findings in the context of recent developments in infant neuroscience. She highlights the implications of these methodological advancements and offers a forward-looking perspective on the field's future. Her conclusion emphasizes the growing shift towards understanding brain development not only at the individual level but also through an interpersonal lens. This symposium thus provides an inspiring look at how novel approaches are reshaping our understanding of early brain development and encourages developmental scientists to explore the untapped potential of these cutting-edge tools and methodologies.



## Innate and learned components of object vision

**Rhodri Cusack, Cliona O'Doherty**
Trinity College Dublin, Ireland

Awake fMRI is providing a new window onto infant neurodevelopment. We have acquired the largest cohort of infants to date (N=133 at 2 months and N=65 at 9 months) to characterise how early cognition develops. We found that with engaging panoramic in-bore visual stimulation, 2-month-olds participated with a high success rates (97%), typically for 20 minutes of fMRI. We found that even 2-months-olds have rich visual categories. These propagate from higher to earlier visual regions through development, suggesting an unexpected interplay between an innate category template and experience-driven learning.

# A brand-new window into the infancy of the human brain: introducing magnetoencephalography with optically-pumped magnetometers (OPM-MEG)

**Giulia Orioli, Andrew Quinn, Ana Pesquita, Karthika Kamath, Andrew J. Bremner, Ole Jensen, Anna Kowalczyk, Barbara Pomiechowska**

University of Birmingham, UK



The infant brain undergoes dramatic changes while supporting the emergence of complex cognitive functions. Magnetoencephalography with optically pumped magnetometers (OPM-MEG) is the first infant-friendly imaging technique to combine high spatial and temporal resolution, opening an unprecedented perspective on the developing brain and mind. We describe one of the world-first OPM-MEG infant setups and report results from two auditory oddball tasks. Due to the requirement to cool sensors to less than ~-265 °C, traditional MEG systems use one-size-fit-all helmets unsuitable for developmental populations. Instead, OPM-MEG uses lightweight sensors that work at room temperature and can be flexibly deployed next to the scalp, making OPM-MEG ideal for infants and young children. While OPM-MEG has been increasingly employed in adult research, its application to infant research is just beginning. Through an interdisciplinary collaboration between physicists, neuroscientists and psychologists, we built one of the world-first developmental OPM-MEG labs, developed procedures to test infants, and undertook a validation study, using 50 FieldLine Inc. OPM sensors. Two-month-olds (5 infants so far, average = 57 days, data collection ongoing) participated in two short experiments followed by a resting state recording during an approx. 25-minute scanning session. The experiments involved auditory oddball tasks with pure tones (500 Hz, 750 Hz, Experiment 1) and syllables (“ma”, “to”, Experiment 2), assessing auditory evoked and oddball responses. Clear evoked responses were observed in individual participants, see Figure 2 for an example. Power spectra showed peaks around 4 Hz and 6 Hz, in the theta and alpha bands, respectively. A successful application of OPM-MEG to infant imaging is poised to push back the boundaries of MEG and neuroscience research, breaking new grounds in the understanding of the developing brain and emerging cognition. Our work provides a proof of feasibility and a first characterization of OPM responses in 2-month-olds.

## Resonance phenomena in developing neural networks – infant brains tick at 4Hz

**Marlena Baldauf[1], Ole Jensen[2], Moritz Köster[1]**

[1]University of Regensburg, Germany; [2]University of Birmingham, UK

The present study extends findings on resonance phenomena from the adult literature to the infant brain. Hermann (2001) applied rhythmic visual stimulation at different frequencies (1-100Hz) to adults. Along with rhythmic brain responses at base frequencies and their harmonics, results showed a consistent resonance phenomenon at the 10Hz alpha frequency. Similarly, Van Rullen and MacDonald (2012) found a ~10Hz resonance response following random white noise stimulation, suggesting the visual system echoes recent visual perceptual information at this frequency. Despite growing interest in neural oscillations during infancy, research on resonance phenomena in the infant brain has been lacking. Our study addresses this gap and also examines resonance phenomena in the ~4Hz theta range, given its importance in infants' information processing (Begus et al., 2015; Köster et al., 2019). We recorded N = 50 seven-to-nine-months-old's EEG while presenting images of cartoon monsters flickered at eight frequencies (2, 4, 6, 8, 10, 15, 20, 30Hz) and in randomized luminance sequences with a flat frequency spectrum. Results from Continuous Wavelet Transformation revealed increased power at base frequencies and harmonics, but unlike in adults, no resonance phenomenon was observed at ~10Hz in infants. Instead, a resonance phenomenon emerged at 4Hz theta, with increased power at this frequency regardless of stimulation frequency. Further, cross-correlating white noise with the corresponding EEG signal revealed an oscillatory echo with strong power at the theta frequency. Our findings highlight the importance of the theta band in infants' information processing, aligning with previous research identifying theta as dominant frequency in young children, shifting towards alpha around 7 years of age (Cellier et al., 2021). This contrasts with adult literature, which shows resonance phenomena in alpha. The results will be discussed in the light of different hypotheses on the functional relevance of theta and alpha in infant and adult brains.

# PAPER SESSION 5

## LANGUAGE

Saturday, 11 January 2025, 16:30-17:30

**Chair:**
Munther Ahmed

### Pupillary entrainment to natural speech reveals the development of bottom-up and top-down processes in speech perception

**Alan Langus, Barbara Höhle, Birgit Elsner**
University of Potsdam, Germany



To understand spoken language, listeners must parse continuous speech into words and discover how words combine into sentences. Adult listeners achieve this by relying on bottom-up processes that exploit the perceptual regularities in the prosody of spoken language and/or on top-down processes that exploit the acquired knowledge of the syntactic structure and the mental lexicon of their native language. Here we investigate how these processes interact and how they develop when language is acquired. Specifically, we test how adults, children, and young infants weigh prosodic cues and acquired syntactic knowledge to parse natural sentences. German-speaking adults (N=32), 3.5-year-old children (N=24), and 8-month-old infants (N=32) listened to passages of German sentences where pauses were inserted either within clauses or at clause boundaries and prosodic cues signaling clause boundaries were either added or removed from the syllable preceding the pauses. This resulted in four experimental conditions: (1) prosodically well-formed boundaries at syntactically plausible positions (bottom-up+, top-down+); (2) prosodically well-formed boundaries at syntactically implausible positions (bottom-up+, top-down-); (3) prosodically ill-formed boundaries at syntactically plausible positions (bottom-up-, top-down+); and (4) prosodically ill-formed boundaries at syntactically implausible positions (bottom-up-, top-down-). We measured how well participants' pupils entrained to the amplitude envelope of these sentences. We show that listeners' ability to use on bottom-up and top-down cues develops during the first years of life. Eight-month-old infants' pupils entrained significantly more to prosodically well-formed than ill-formed sentences, irrespectively whether the boundaries appeared at syntactically plausible or implausible

positions. 3.5-year olds' and adults' pupils entrained best to sentences with prosodically well-formed boundaries at syntactically plausible positions, suggesting that they integrate top-down and bottom-up processes when parsing natural speech. Our results show that pupils can entrain to natural speech, and reveal how infants, children, and adults rely on bottom-up and top-down processes to parse structure from continuous speech.

## Linking auditory memory and language development: a study with italian-learning infants

**Chiara Nascimben, Tamara Bastianello, Natalia Reoyo-Serrano, Silvia Benavides-Varela**
University of Padova, Italy

Working memory (WM) plays a crucial role in cognitive development and predicting educational outcomes, such as language acquisition and vocabulary development, since early childhood (Baddeley et al., 1998; Gathercole & Pickering, 2000; Kane et al., 2004). While visual WM has been deeply investigated less is known about auditory WM and its development through the first years of life. Research shows that children develop adult-like auditory memory capacity later than visual memory, usually during primary school (Gathercole & Baddeley, 1989; Hoff et al., 2008). Studies on infants suggest a capacity of up to 3 (Benavides-Varela & Reoyo-Serrano, 2021; Newman & Simpson, 2023) however, it is unclear how this might be related to language development. Our study aims to broaden our knowledge on this matter by investigating auditory WM capacity in 57 infants and its association with language abilities. To assess auditory WM, we adapted Kovacs's (2008) paradigm to evaluate infants' ability to remember sequences of syllables and to predict upcoming events through rapid-learning blocks that change in the length of syllables according to each infant's performance. All children started with sequences of 3 syllables as in previous studies infants could successfully learn information out of three-syllable sequences (e.g., Saffran et al., 1996; Kovács & Mehler, 2009; Kabdebon & Dehaene-Lambertz, 2019). A difference score was used to determine the memory span for each child. Results showed memory span positively correlated with infants' linguistic abilities (i.e., Child Vocalization Count per min (CVC/min)) as measured by the Language Environment Analysis recording device (LENA; r=.388, p=.003). Moreover, infants with a higher memory span showed higher CVC/min (M=2.68) if compared with children with a lower memory span (CVC/min=1.82; p=0.016). Our findings provide new insights into the relationship between auditory WM and language development suggesting that auditory WM may play a fundamental role in supporting language acquisition.

# The differential impact of birthweight and gestational age on newborns' brain responses to language

**Noémi Szeberényi[1,2], Judit Gervain[3,4], Jessica Gemignani[3]**

[1]University of Padua, Italy; [2]Budapest University of Technology and Economics, Hungary; [3]University of Padua, Padova Neuroscience Center, Italy; [4]Université Paris Cité & CNRS, France

Language acquisition is a complex process already influenced by prenatal neural development and auditory experiences. From the third trimester fetuses perceive sounds already influencing the fetal brain (e.g., Birnholcz & Benacerraf, 1983; Eggermont & Moore, 2012; Gervain, 2015; Nallet & Gervain, 2021). The current study examined the effects of prenatal experience and neural maturation on early language development. The objective was to investigate how the length of intrauterine language exposure, indexed by gestational age (GA), and overall maturation, indexed by birth weight (BW), affect newborns' brain activations and linguistic abilities. Data from 14 NIRS studies (Abboub et al., 2016; Bouchon et al., 2015; Martinez-Alvarez et al., 2022; Benavides & Gervain, 2017; Bouchon, 2014; Marino et al., unpublished) including 192 1-4-day-old newborns were analyzed to assess changes in oxygenated (HbO) and deoxygenated hemoglobin (HbR) levels in response to linguistic stimuli. Results showed that for HbO responses compared to baseline higher BW was associated with increased activations in the right hemispheric frontal regions. For HbR compared to baseline, increasing BW led to increased activations in the frontal and decreased activations in the temporal regions of the left hemisphere, while in the right hemisphere the opposite pattern was observed. For differential HbR responses, i.e., HbR differences between conditions, a more positive effect was observed in the temporal regions. Besides, BW yielded stronger activations in the frontal, while GA showed stronger activations in the temporal regions. Further, HbR was more strongly correlated with prenatal experience and maturation than HbO, challenging the exclusive use of HbO in newborn studies. The findings suggest a differential impact of BW and GA on brain activations, reflecting their roles in biological maturation and auditory discrimination, respectively. Overall, the study suggests that the length of prenatal experience and maturation play a significant role in early brain and language development.

# PAPER SESSION 6

## OBJECT REPRESENTATION

Saturday, 11 January 2025, 17:45-19:00

**Chair:**
Mariem Diané

### Why children count partial objects: categorization and number knowledge

**Athulya Aravind[1], Karissa Sanchez[1], Kristen Syrett[2]**
[1]Massachusetts Institute of Technology, USA; [2]Rutgers, The State University of New Jersey – New Brunswick, USA



When asked to count under basic-level noun descriptions ("fork"), children count both wholes and 'discrete partial objects' (Shipley & Shepperson, 1990). One hypothesis is that children over-count because they over-apply noun-predicates to discrete parts (Syrett & Aravind, 2022). Here we probe the relationship between predicate application and object counts in a study integrating categorization and numerical judgments. We compare nouns (NOMs) with two classes of gradable adjectives with distinct application criteria: maximal (MAX) gradable adjectives ("full") and minimal ones (MIN) ("striped"). For "full" to apply, an object must be maximally full, whereas for "striped" to apply, the object only has to display some stripes. In the Categorization Task (A), participants sorted sets of 7 objects instantiating these (NOM/MIN/MAX) properties in sequential degrees. In the Numerical Judgement Task (B), they saw a dyad from this set, one maximally displaying the property and one displaying it partially, and evaluated the statement, "You brought me { NOMs}/{ MAX/MIN (ones)}", where was "one", "one-and-a-half", or "two." In (A), adults' treatment of NOM resembled MAX: partial objects were categorized like non-MAX objects, as non-category members. In contrast, children treated NOM like MIN. In (B), adults rarely accepted "two NOMs" for a whole-partial dyad. While they robustly accepted "one-and-a-half NOMs", they never accepted "one-and-a-half {MAX/MIN} ones", consistent with adjective semantics (half-full isn't "full"; half-striped is "striped"). Children accepted "two NOMs/two MIN ones," and rarely accepted 'one-and-a-half' with any category. Strikingly, children's numerical judgments were often incongruous with their categorization: even

after not categorizing a partial-object as NOM, they accepted "two NOMs" for a whole-partial dyad. We suggest that children both use a MIN-like criteria for noun application, and furthermore, lack fractional measures. They recognize that the set cardinality is >1, but absent a finer-grained numerical scale, their best option is 2.

## Infants individuate up to three objects if the last-seen object remains visible

**Yi Lin[1], Renée Baillargeon[2]**

[1]New York University, USA; [2]University of Illinois at Urbana-Champaign, USA



Infants aged 14 months and younger fail at standard individuation tasks involving two objects that differ only in their featural properties. For example, after two objects that differ only in color and pattern emerge in alternation from behind a screen, infants are not surprised to see only one object when the screen is lowered (Lin et al., 2024; Xu et al., 2004). According to the two-systems model, this failure reflects how the object-file and physical-reasoning systems operate and interact in infancy (Lin et al., 2022, 2024). Here, we test a new and striking prediction from the model: Infants should succeed at a standard individuation task involving two or even three featurally distinct objects as long as the last-seen object remains in view when the screen is lowered. In our experiment, 11-month-olds were assigned to a 1-object (baseline), 2-objects, or 3-objects condition, and they saw either a hidden- or a visible-at-the-end event. In the hidden-at-the-end event, after the last-seen object returned behind the screen, the screen was lowered to reveal only that object. In the visible-at-the-end event, the last-seen object did not return behind the screen but remained visible next to it. No object was revealed when the screen was lowered, so that the last-seen object was again the only one present. Next, the object moved behind the lowered screen, to equate the final displays of the two events. In the 1-object condition, infants looked equally at the final displays of the hidden- and visible-at-the-end events. In the 2- and 3-objects conditions, however, infants who saw the visible-at-the-end event looked significantly longer, suggesting that they detected the individuation violation in the event. These results support the two-systems model and its central claim that early individuation is best understood by considering how the object-file and physical-reasoning systems operate and interact in infancy.

## The development of rapid face categorization from infancy to adulthood: Evidence from frequency-tagging EEG

**Diane Rekow[1], Sofie Vettori[2], Aliette Lochy[3], Bruno Rossion[4], Jean-Yves Baudouin[5], Arnaud Leleu[6]**

[1]University of Hamburg, Germany; [2]Université Claude Bernard Lyon 1, France; [3]University of Luxemburg, Luxembourg; [4]Université de Lorraine, France; [5]Université Lumière Lyon 2, France; [6]Université de Bourgogne, France

To study the development of face perception, scalp electroencephalography (EEG) has been routinely used. However, standard EEG approaches make it difficult to extract comparable information across developing populations. Here, we report the development of face-selective neural activity using frequency-tagging EEG to isolate a neural marker of rapid face categorization across age groups. We gathered data collected across 5 age groups (N=140 in total): 4-to-6-month-olds (N=27), 8-to-12-month-olds (N=26), 5-year-olds (N=33), 10-year-olds (N=27) and 22-year-olds (N=27). All groups were exposed to similar fast periodic visual stimulations, where various face exemplars were presented at a fixed interval within streams of nonface stimuli to tag 2 distinct neural responses at distinct frequencies and harmonics (integer multiples): a general visual response to all stimuli (6 Hz) and a face-selective response (1.2 Hz) reflecting rapid face categorization. Results show that while the face-selective response is already present in the youngest infants, its amplitude increases with age at lateral posterior regions, reaching a maximum in children. The response is observed on a single harmonic at 4-6 months and becomes progressively distributed on more harmonics in a linear fashion, reflecting a mono-component slow response starting from 245 ms after stimulus-onset at 4-6 months that evolves to a faster (from 115 ms) multi-component response in adults. The response becomes less variable across participants with age. In contrast, the general visual response is reliably high from the youngest age tested, with a comparable distribution across harmonics and age, and a shared topographical distribution. Combined together, these results highlight the maturational changes of the visual system and the tuning of the face-selective network with development. Thus, using the same approach across age groups, we are able to characterize quantitatively and qualitatively the development of a neural signature of rapid face categorization from infancy to adulthood at both group and individual levels.

## Speech matters: Effects of auditory stimulation on visual categorization in the infant brain

**Milena Marx[1], Stefanie Peykarjou[2]**

[1]Heidelberg University, Germany; [2]Charlotte-Fresenius Hochschule Wiesbaden, Germany

By the age of 4 months, infants are able to categorize human faces at a glance. However, the environmental factors that support this developmental milestone remain contentious. This study explores the potential role of auditory-visual interactions in facilitating visual categorization, particularly focusing on the influence of infant-directed speech (IDS), compared to adult-directed speech (ADS), and silence. Prior research suggests that maternal odor can enhance visual categorization in infants as young as 4 months (Leleu et al., 2020). Here, we investigate if other sensory modalities, particularly auditory cues, offer similar benefits. Beyond the finding that children prefer IDS (ManyBabies Consortium, 2020), neurobehavioral research suggests specific neural mechanisms, such as facilitated cortical tracking of auditory input, that underlie the advantages associated with IDS (Kalashnikova et al., 2018). Furthermore, IDS can serve as an ostensive cue, fostering referential expectations (Parise & Csibra, 2013; Sirri et al., 2020). Given the early developmental importance of face recognition, as indicated by face-selective neural activity in infants (de Heering & Rossion, 2015), IDS might significantly impact visual categorization of this social category. To assess the impact of IDS versus ADS or silence on visual categorization, fast periodic visual stimulation (FPVS) is employed. Social and non-social target categories are compared using images of faces and cars. Target stimuli are embedded in a randomized stream of highly variable objects. EEG activity is analyzed at both the frequency of stimulus presentation (6 Hz and harmonics) and the frequency of categorization (1 Hz and harmonics) using Bayes factor repeated-measure ANOVAs. Data (N = 55) suggests that IDS enhances visual categorization in 4-month-olds, particularly for faces. An ongoing comparison of IDS and silence (expected N = 30) aims to further validate these findings. If confirmed, the results underscore the extensive role of IDS in early sensory and cognitive development.

# BC3D

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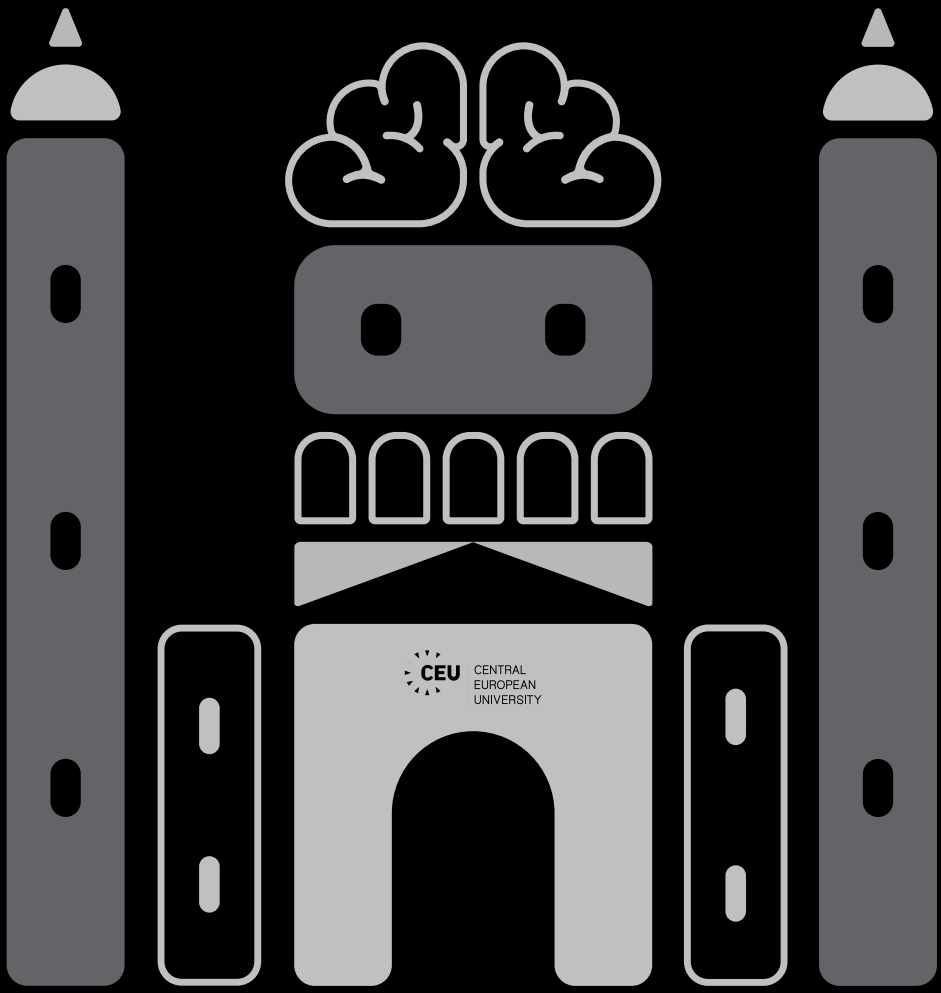

# POSTER SESSION A: THURSDAY

## PA-02 Toddler's symbolic play in dyadic mother-child and triadic mother-child-older-sibling interactions

Sharon Sherman, Naomi Havron
University of Haifa, Israel

Symbolic play is characterized by a complex representation of objects. Such play is a significant developmental milestone, linked to cognitive and social development (Kowalski et al., 2004). Symbolic play with a parent usually provides favorable conditions for the development of this ability (e.g., Marjanovič-Umek et al., 2014). However, findings are scarce with regards to play that also involves a sibling in addition to a parent. It suggests that alongside possible positive influences (e.g., Kowalski, 2000), triadic play may also contain characteristics that hinder the development of symbolic play (Finn & Vandermaas-Peeler, 2013). The current study examined the symbolic play of toddlers in a dyadic play interaction with their mother, and a triadic play interaction, which included, in addition, their older sibling. We hypothesized that in the dyadic condition the toddler's symbolic play would have higher frequency, duration, variety, initiative, and complexity compared to the triadic play condition. The study included 20 participants (aged 1.7-2.5 years), along with their mothers and siblings (3.5-7.5 years). Toddlers participated in two videotaped free-play conditions, and the measures of symbolic play were coded and compared between them. As hypothesized, we found that in the dyadic play condition, toddlers' level of symbolic play was higher than in the triadic interaction, in their overall Z-score ($t(17) = 5.494$, $p < 0.0001$, $d = 0.956$); and in all individual measures of play (from $p = .0416$ to $p < .0001$). These findings underscore the importance of dyadic play for toddlers' symbolic development, and suggest that the presence of a sibling may pose challenges for the emergence of symbolic play. Further research is needed to elucidate the specific factors influencing symbolic play in triadic interactions - and examine whether they hinder symbolic play, or whether they are just not as helpful as dyadic interactions.



## PA-03 Through the eyes of a baby: Exploring infants' motor learning via eye movements

Tal Ravid-Roth[1], Romi Livne[2], Baruch Eitam[1], Sagi Jaffe-Dax[2]
[1]University of Haifa, Israel; [2]Tel-Aviv University, Israel

Infants transition from random movements to intentional actions in their first year. Our research examines reinforcement learning's role in this process, using voluntary gaze control to understand motor development. Early eye movement control in infants suggests a link between motor patterns and perceptual changes, potentially as a blueprint for linking motor and perceptual development. We propose that infants anticipate sensory changes from planned movements, developing internal models based on the motor system. These abilities indicate that sensorimotor prediction computations are within infants' cognitive capacities, highlighting their active role in understanding their environment. We conducted two studies tracking infants' eye movements as they viewed objects on a screen.

Each trial had a target object that moved when looked at, and distractor objects. In Experiment 1, 24 infants (M=10.13 months, SD=2.19, 11 females) viewed four objects (one target, three distractors). In Experiment 2, 22 infants (M=8.24 months, SD=2.04, 8 females) viewed two objects (one target, one distractor) to test if infants would gaze more at an object with equal movement probability. Bayesian analyses revealed differences in infants' dwell times on target versus distractor objects in both experiments. In Experiment 1, Bayesian repeated measures ANOVA showed that including object type improved model fit ($BF_{10}$ = 1.498). Bayesian paired samples t-tests indicated moderate evidence that infants gazed longer at the target than at distractors ($BF_{+0}$ = 3.308). In Experiment 2, Bayesian paired samples t-tests showed strong evidence that infants gazed longer at the target than the moving distractor ($BF_{+0}$ = 2.955). Our findings suggest that infants' looking behavior is positively reinforced by their motor control over an object, indicating their active engagement in cause-and-effect learning. This supports the notion that the developing motor system provides a rudimentary, yet robust, form of cause-effect learning directly translated to the reinforcement of the 'causally effective' motor program.

## PA-04 Metaphor comprehension in preschool children

Pelin Küçükerdoğan, Deniz Tahiroğlu
Boğaziçi University, Turkey



Metaphor comprehension in children has been a topic of interest since Piaget (1926). Contrary to previous beliefs that metaphoric understanding emerges at the formal operational stage (Asch & Nerlove, 1960), recent findings suggest preschool children can comprehend metaphors when the metalinguistic demands of tasks are removed (Pouscoulous & Tomasello, 2020; Vosniadou et al., 1984). While these studies demonstrated young children's ability to understand physical metaphors, fewer have explored their comprehension of psychological metaphors and the factors affecting the process. This study addresses this gap by presenting ambiguous stories containing metaphorical phrases to 62 Turkish-speaking children. Participants were asked to identify the emotion of the story character (revealed in the metaphoric phrase only) by selecting the correct picture. Individual differences in cognitive abilities (executive functioning [EF], pretend play, and language competence) and metaphor-related factors (context and familiarity) were investigated in relation to children's metaphor comprehension. Overall, children were more likely to choose the picture depicting the correct emotion revealed in the metaphorical phrase compared to distracters and incorrect pictures. Furthermore, a positive relationship between EF abilities and metaphor comprehension was found, while no correlation was found with pretend play and language complexity. Analyses partially supported that when the context in which the metaphor is presented is easier, children show more comprehension, and, the performance with the more familiar metaphors was higher than the less familiar metaphors. Looking at the interaction between EF and familiarity of metaphors, findings suggest that EF might have a more profound contribution to the comprehension of less familiar metaphors compared to more familiar ones. Overall, these findings replicate and extend the studies

that suggest even preschool children can understand psychological metaphors (Waggone & Palermo, 1989) and emphasize the importance of investigating the effects of cognitive and metaphor-related factors together to understand factors contributing to metaphor comprehension development.

## PA-05 GPT-3 and child comprehension: A case of Korean suffixal passive construction

Gyu-Ho Shin[1], Seongmin Mun[2]

[1]University of Illinois at Chicago, USA; [2]Ajou University, South Korea

While computational methods/techniques are increasingly prevalent in language-development research,[1,2,3,4] studies focusing on non-English languages remain sparse.[5] This study examines GPT-3's ability to address children's comprehension behaviour, focusing on Korean suffixal passive—a known challenge in language acquisition.[6,7;cf.8]. Passive morphology necessitates realigning thematic roles and case markers against initial interpretation, resulting in mapping THEME to nominative-marked arguments and AGENT to dative-marked arguments. We test if GPT-3 recognises passive morphology and perform required revisions, comparing this to children's picture-selection performance measured in [7]. The pre-trained model, originally built on adult language usages, was patched[cf.9,10] on caregiver-input data[11] to increase ecological validity. The model was fine-tuned on instances of all constructional patterns expressing transitive events—active transitive and suffixal passive, with scrambling/omission of sentential components—with labels indicating whether the thematic-role ordering followed Agent-First or Theme-First. The fine-tuned models classified the same test sentences as used in [7], evaluating Agent-First or Theme-First categories. Varying hyperparameters did not substantially adjust model performance. We compared the children's response patterns with the models' binary-classification outcomes. In each of 10 epochs, we repeated the learning process 30 times and averaged classification outcomes to mitigate task variations. The models demonstrated sensitivity to disambiguating morphemes, aligning partially with children's responses in the Agent-First conditions but showing inconsistencies in the Theme-First and one-argument case-less transitive conditions. The models' failure to faithfully simulate suffixal-passive conditions indicates GPT-3's limitations in recognising passive morphology and conducting necessary revisions. Architectural characteristics,[12,13,14] together with language-specific properties and differences between simulation and experimental settings, may have influenced these outcomes. Our findings suggest that, while transformers may interpret linguistic forms, their processing diverges from that of child/developing processors given their learning trajectories.[15,16,17] The limitations of computational models in addressing child language features invite further inquiry into how these models can illuminate language development informed by corpus-based/experimental studies.

## PA-06 The effect of information scope and content on Arab children's attitudes toward Jews in Israel

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Research suggests that children construe in- and out-groups differently. Arguably these biases relate to what children know – or don't know – about groups. The present studies investigated whether the provision of different types of information alters children's intergroup biases. In Study 1, Arab Israeli children (97 kindergarteners and 97 second graders) were randomly assigned to one of three conditions varying in the scope of information provided: "no information", "individual information" (e.g., Moran the Jewish girl lives in the city of Tel-Aviv), and "category information" (e.g., There are many Jews who live in the city of Tel-Aviv). Before and after providing (or not) the information, we assessed children's attitudes (e.g., social distance task) and essentialism regarding Jews. As can be seen in Figure 1, the provision of category information led to more negative attitudes toward Jews. In contrast, the provision of individual information led to more positive attitudes and lower essentialism regarding Jews. In Study 2, Arab Israeli children (98 kindergarteners and 99 second graders) were randomly assigned to one of three conditions varying in the content of information provided: "no information", "psychological information" (e.g., This Jewish girl can dance), and "personal identity information" (e.g., This Jewish girl is 7 years old). Before and after providing (or not) the information, we assessed children's attitudes and essentialism toward Jews. As displayed in Figure 2, providing personal identity information worsened Arab children's attitudes toward Jews and heightened essentialism. Conversely, providing psychological information improved Arab children's attitudes towards Jews and lowered essentialism. Overall, this research demonstrates that providing individual and psychological information about outgroup members significantly fosters more positive attitudes among children. These findings highlight the importance of incorporating individual and psychological information in interventions aimed at improving intergroup attitudes.



## PA-07 The relationship between cognitive and morphological skills: Evidence from Turkish kindergarten children

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This study investigated the role of domain-general cognitive processes, specifically inhibitory control, verbal working memory (WM), and nonverbal reasoning, on children's productive use of grammar, focusing on Turkish inflectional (e.g., fırçala-DI brush-PAST.3sg) and derivational morphology (e.g., fırçala-t-TI brush-CAUSE.3sg). We tested 84 5-year-old (40 female) Turkish-learning children on a sentence completion task with familiar and novel verbs to assess their use of morphology. Children were more successful in producing the correct suffix for inflectional than derivational morphology when using both familiar ($\beta = 1.59$, $SE = 0.29$, $p < .001$) and pseudo verbs ($\beta = 3.13$, $SE = 0.40$, $p < .001$).

Zero-order correlations showed significant relations between correct suffix use and all cognitive assessments ($r = .26$ to $.29$, $p < .05$). However, regression analyses revealed that only nonverbal reasoning predicted children's overall correct suffix use ($\beta = 0.79$, $SE = 0.31$, $p < .05$) and inhibition predicted it only for inflectional morphology with pseudo verbs ($\beta = 1.05$, $SE = 0.38$, $CI = [0.09\text{-}2.00]$). Hence, children who have better reasoning abilities may have more robustly abstracted the grammar rules of their native language. Children with better inhibitory control can more effectively suppress the primed present tense verb and correctly use the past tense. This ability is particularly evident when dealing with pseudo verbs, which make the task more abstract. These findings imply the consideration of domain-general cognition in the development of abstract grammar in childhood.

## PA-08 Navigating friendships: Cultural and age variations in conflict resolutions

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Emerging adulthood is a crucial period, particularly for interpersonal relationships (Arnett 2000). Conflicts are inevitable during this time, leading individuals to use various conflict resolution strategies (CRS), which are crucial for maintaining friendships (Laursen et al., 2001; Thayer et al., 2008). These strategies might vary by culture and age (Holt & DeVore, 2005). Since most studies focus on work settings (Stahl et al., 2009), this observational study explored cultural differences in conflict resolution among close friends, considering age. In total, 76 Dutch and 54 Turkish emerging adults ($M(SD) = 24(2.02)$; age range = 18-29) participated in three phases. Firstly, they rated controversial statements and their friendship quality. Based on the survey, statements causing disagreement were chosen to create conflict between friends in the online sessions. Participants rated their own behavior in the end. Recorded sessions were coded to assess dominant and submissive behavior and CRS (C-FIRS; Lansu & Cillessen, 2015). Results revealed no cultural differences in CRS. However, behaviors during conflict discussions differed between cultures. Observations indicated that Turkish people displayed more dominant ($M = 2.70$, $SD = .94$) and submissive behavior ($M = 1.98$, $SD = .80$) compared to Dutch people (dominance: $M = 1.04$, $SD = .14$; submissiveness: $M = 1.00$, $SD = .00$). Parallel to observations, Turkish people ($M = 4.02$, $SD = .99$) reported more submissive behavior ($M = 2.88$, $SD = .90$), $p < .001$. Contrary to observations, Turkish people ($M = 2.32$, $SD = 1.29$) reported less dominant behavior than Dutch people ($M = 3.04$, $SD = 1.37$), $p = .031$. Regardless of culture, dominance ($rs = -.50$, $p < .001$), submissiveness ($rs = -.44$, $p < .001$), and friendship quality were negatively associated with age ($rs = -.28$, $p < .001$). This study highlights changes in social relationships during emerging adulthood across cultures.

## PA-09 Do children use mental simulation to solve problems with multiple alternatives?

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As adults we readily work through alternative possibilities and their potential consequences in our minds before acting (mental simulation). This enables us to internally explore alternatives without incurring costs of acting in reality. Young children are highly exploratory in the real world, but little is known about their ability to internally explore via mental simulation. We used a computer-based vertical maze task to investigate (1) developmental changes in the use of mental simulation when choosing between alternatives; and (2) the influence of resource availability on children's tendency to simulate. In block 1, participants (33 adults, 84 4-7-year-olds) saw 18 mazes where they chose which of three entrances to drop a ball into to reach a goal. An effective strategy is to simulate the path the ball will take through the maze. Accuracy increased with age (child data GLMM: $b = 1.01$, $SE = 0.16$, $p < 0.001$, whereas latency to choice decreased (LMM: $b = -0.59$, $SE = 0.21$, $p = 0.006$). Young children spend longer making their choice but this does not translate into choosing accurately, suggesting they may not engage in mental simulation, or their simulations may be ineffective. In block 2, 4-7-year-olds (current N=43; data collection ongoing) completed a modified version of the task involving 6 mazes where the aim was to get 3 balls into the goal, and they either had 3 balls (scarce resources) or 5 balls (excess resources). In the 5-ball condition, children could rely more on active exploration (trying different options) to reduce cognitive load. If this is the case, we expect to find higher accuracy and longer latency to choice for the first ball in the 3-ball vs 5-ball condition. Our findings will contribute to understanding children's problem-solving, and could lead to a new conceptualization of their exploratory behaviour.



## PA-10 Error-monitoring in 12-month-old infants: a stepping stone for metacognition & self?

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Error monitoring is a crucial cognitive ability for adaptive behaviour and learning. While newborns already detect deviants in their environment (Cheour et al., 1998), the capacity to monitor one's own errors for active learning develops later. One study showed that 12-month-old infants exhibit a neural signal characteristic of error detection, the Error Related Negativity (ERN), after making incorrect responses and prior to feedback (Goupil & Kouider, 2016). In the current study, 124 12-month-old infants performed a match-to-sample task on a gaze-responsive screen with concurrent EEG recordings. We aimed to 1) confirm infants' ability to monitor their errors with a novel task, 2) investigate whether infants are able to use this response and actively guide their information search, 3) explore the link between this early (meta)cognitive ability and a later complex metacognitive function: infants'

developing sense of self, measured in a mirror self-recognition test 6 months later. We show that 1) infants monitor their own errors: they exhibit an ERN signal after they picked the incorrect option ($p = 0.041$); 2) infants make use of their error monitoring and both explore more in more error-prone difficult trials ($p = 0.028$), and after making an error ($p = 0.05$); 3) infants' developing sense of self probed 6 months later was linked with a stronger ERN at 12 months: 18-month-old infants passing the mirror test showed a significant ERN at 12 months ($p = 0.022$), whereas the ERN effect was not significant in those not showing evidence of mirror self-recognition. Our results show that already at 12 months, infants internally monitor the accuracy of their decisions (metacognitive monitoring), adaptively gather information according to task demands and own performance (metacognitive control), and that these processes may be a stepping stone for the development of more complex metacognitive functions, namely their sense of self.

## PA-11 Counting the number of objects in an object-individuation paradigm

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How do kids who only know a few small numbers (subset knowers) represent them? One influential hypothesis (Carey, 2009) is that subset knowledge links to an early emerging capacity to individuate physical objects and represent them in working memory (Xu and Carey, 1996). In this preregistered experiment we tried to test this hypothesis by probing the connection between object individuation and number knowledge. We presented children (30-54M, N=57, 34 Subset) with infant object-individuation-like stimuli (6 conditions C1-C6) and asked for their numerical judgment about the objects ("Was there one x or two x?"). In some conditions, we found that children's numerical judgements align with prior infant individuation results. In conditions where an object emerged once from one location (C1) or once from one of two locations (C2), children overwhelmingly responded "one". In the condition where two objects simultaneously emerged (C6), they responded "two". In three other conditions, we found less robust numerical intuitions. In C5, the spatial object individuation condition (an object emerges from behind each of two occluders sequentially), and in C4, the featural object individuation condition (two different looking object of the same kind emerges from two locations), children said "2" but less often than in C6. Children had the most varied expectations when a single object emerged twice from one location (C3). These conditions show a striking dissociation from infants who already have clear expectations for 2 (C4-C5) or for 1 (C3) objects in similar scenarios (Xu, 2007 for review). Pulling together all 6 conditions, we interpret the pattern as showing that children indeed use object individuation to inform their number judgments. But as opposed to infants, they do not seem to represent the minimum amount of objects based on the spatiotemporal/visual information. Instead, they also try to infer the number of objects a trial communicates about.

## PA-13 Intergroup bias in children's preference for in- vs. out-group informants

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Children rely on others for knowledge about the world (Harris et al., 2018). This knowledge, however, is often times biased, and its effect on children's attitudes and beliefs is substantial. In fact, children's own requests and processing of information is biased (Nasie & Diesendruck, 2020; Over et al., 2018). The present research explored whether children manifest intergroup biases in their choice of informants from in- vs. out-groups. Two studies were conducted among Israeli Jewish and Arab children aged 5 and 8 (N = 260; 51% girls). Study 1 served as a baseline that assessed potential biases regarding non-social information (places). Study 2 assessed potential biases regarding social targets (people). The experimenter showed participants a picture of a target (a place in Study 1 or a person from in- or out-groups in Study 2), and presented to participants two possible informants, who varied in their group membership: in-group (Jew/Arab), "conflict" out-group (Arab/Jew, respectively), or "neutral" out-group (Scot) and could provide information about the target. In each trial, children were asked three questions, through which their biases could be explored: 1) Who they think knows the most about the target (informant's expertise); 2) Which of the two informants they want to consult to receive information about the target (informant's preference); and 3) Whose advice (positive or negative) they accept (informant's trust). Results revealed intergroup biases in children's choices of informants, such that children preferred receiving information from in-group than either out-group informant, and avoided requesting information from conflict out-groups more than neutral ones. Moreover, these biases were particularly strong when learning about people, and among younger and minority group children (Arab). The findings highlight how epistemic and social identity cues affect informant's choice. This has important implications regarding how to transmit information to children about different groups.



## PA-14 Neural mechanisms underlying object search and explicit belief reasoning in pre-school children

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Previous research indicates that implicit and explicit belief reasoning rely on different neural networks. In these studies, non-verbal false belief tasks were used. Another potential form of implicit belief processing is evidenced by involuntary interferences from others' beliefs, even when these beliefs are irrelevant to the current task. In contrast to non-verbal false belief tasks, such altercentric biases seem to depend on explicit belief reasoning, both in adults and preschool children. This raises the question which processes underlie these biases and what their relation to explicit belief processing is. We address this question by comparing the brain regions activated for altercentric biases compared

to explicit belief reasoning in preschool children, using functional near-infrared spectroscopy. We tested N=91 children aged 3-5 years with a continuous false belief task (Bernstein, 2011), which measures explicit belief reasoning by evaluating an egocentric bias in one's judgement of another person's false belief about an object location. In an object search version of this task, we measured an altercentric bias in children's own search for the object's location. This allowed assessing both explicit belief reasoning and altercentric biases within the same task, to directly compare the brain regions involved in these two processes. We hypothesize that children will show neural activity in explicit ToM brain regions (i.e. MPFC, TPJ,PC, MTG, Schurz et al. 2014) in the explicit version. In the object search version of the task, we predict that children will show neural activity in similar regions as for explicit belief reasoning if the same underlying processes are involved. In case of different processes, we predict to find regions of the salience network (e.g. SMG) to be active, which have previously been found to be associated with non-verbal false belief tasks. The data is currently being analyzed and will be presented at the conference.

## PA-15 Math minds at play: Insights into home activities from Kosovo and the US

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The home environment plays a crucial role in developing early math skills through play and games (Sonnenchein et al., 2016). These activities allow children to practice math and problem-solving skills while allowing parents to support learning through examples and feedback in an engaging setting (Clements & Sarama, 2014). Playing math games can enhance arithmetic skills, counting, numeral identification, magnitude comparison, as well as algebra, geometry, measurement and data analysis, all of which contribute to early problem-solving skills (DePascale & Ramani, 2024). This study aims to identify the types of math-related playful activities that children aged 4-9 frequently engage in at home. The research addressed are: a) What are the common math-related activities children engage in at home, and how can they be categorized? b) Do younger children (ages 4-5) differ from older children (ages 6-9) in the types and duration of math-related play? c) Are there cultural differences in these activities between children in Kosovo and the U.S.? Parents of children from Kosovo (N=40) and the U.S. (N=38) were interviewed to elaborate on their children's math-related activities at home. These activities were categorized into four groups: a) Construction and Spatial Reasoning; b) Games and Logical Thinking; c) Math Practice and Reinforcement; and d) Digital Games and Coding. The results showed that the most frequently reported activities were construction and spatial reasoning. While younger and older children engaged in similar math-related activities, older children spent significantly more time on these activities. Similarly, although the types of activities were consistent between Kosovo and the U.S., children in Kosovo spent more time participating in them. The data confirm the importance of understanding the types of math activities children of different ages and cultures engage in at home, while also providing valuable insights into integrating playful math activities at home to foster cognitive development.

## PA-16 Reasoning by exclusion in food caching Eurasian Jays (Garrulus glandarius)

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Reasoning by exclusion has been extensively studied in comparative cognition literature as it may provide insight into the logical capacities of non-human animals (Tomasello & Call, 1997). Two primary methods have been used to test this. The predominant method is Call's (2004) 2-cups task, where animals choose between two opaque cups after being shown that one is empty. A similar task by Premack & Premack (1994) involves hiding two equally desirable rewards and removing one. In both tasks, success requires the subject to identify the cup still holding the reward by eliminating the other as a possible location. Studies show that great apes, some primates, and some corvids can reason by exclusion (Völter & Call, 2017). Among corvids, intense cachers like Clark's nutcracker succeed spontaneously in these tasks, while non-cachers like jackdaws do not (Vander Wall, 1990). Caching demands, such as remembering and avoiding previously recovered or pilfered caches, may enhance exclusion abilities by reinforcing the experience of relevant contraries (e.g., empty vs. full; Bermudez, 2007). Eurasian jays, despite being intensive cachers, failed a modified 2-cups task by Shaw et al. (2013) that involved movement and uncertainty during baiting, possibly reducing their motivation. In two studies we tested seven Eurasian jays on both Call's 1-reward/show-empty and Premack and Premack's 2-reward/remove-1 versions. We amended the procedure by using invisible displacement to hide the rewards, reducing movement of experimenter and items. Jays chose the target cup 85% of the time in Study 1 and 80% in Study 2, showing spontaneous and robust success. This success aligns with the hypothesis that corvids' exclusion reasoning may be influenced by caching behaviour (Schloegl et al., 2011) and the experience of contraries.



## PA-17 Reasoning about possibility and theory-of-mind co-develop in early childhood: A cross-cultural study

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Theory-of-Mind (ToM) is the ability to reason about other people's thoughts and beliefs. A similar developmental breakthrough around 4 years is observed in both ToM and reasoning about abstract concepts, such as possibility and relations, and it has been proposed that they may share a general structure of reasoning (Perner et al., 2011). However, cultural differences in the development of ToM and relational reasoning have been observed between the US and China (Carstensen et al., 2019; Wellman et al., 2006), raising the question whether the development of reasoning across these domains follows a universal common trajectory or depends on culture. To address these questions,

we examined the developmental trajectories of abstract reasoning. We hypothesized that children's performance on ToM task and abstract reasoning tasks are positively correlated, and this relation may depend on culture. We recruited typically developing 3- to 5-year-old children from Germany and China. Children participated in a battery of false belief tasks, a possibility reasoning task, and a relational reasoning task via online meeting. Our data showed that German (N = 54) and Chinese children (N = 47) demonstrated similar age-related development in ToM and possibility reasoning but different developmental trajectories for relational reasoning. Specifically, German preschoolers showed a consistent tendency to reason individually, while Chinese children demonstrated a transition from individual reasoners to relational reasoners between 3 and 5 years. Our findings evidenced that the development of ToM is positively correlated with possibility reasoning in both cultures but not with relational reasoning, suggesting that the development of ToM and possibility reasoning may depend on a general reasoning process that develops in the preschool years, independently of culture. In contrast, relational reasoning seems to be shaped by culture and accordingly is not associated with a more general development of reasoning ability at this age.

## PA-19 Children spontaneously discover efficient sorting algorithms in a seriation task

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Efficient algorithms are necessary for efficient problem-solving in many cognitive domains and daily tasks. Imagine that you are baking a dozen cookies. One approach is to mix the ingredients and bake each individual cookie twelve times. A more efficient approach is to execute the mixing and baking processes only once for the entire batch. Both methods produce identical results, but the latter represents a more efficient algorithm. While this baking example is intuitive because it represents a standard practice, many efficient algorithms for real-world problem-solving and behavior can be difficult to spontaneously discover and use—especially for children. For example, classical seriation studies suggest that children struggle to apply algorithmic strategies to even simple sorting problems (Flavell, 1963; Piaget, 1965; Piaget & Inhelder, 1969). We investigate the spontaneous discovery of algorithmic solutions across development. We gave children a variant of the sorting problem with hidden object ranks. Children, ranging from 4 to 10 years old (N=124), sort 6 bunnies into the right order, from the shortest to the tallest, on a touchscreen computer. The initial heights of the bunnies are randomly generated, and the bunnies are standing behind a wall, so their heights are not visible. Our results show that children performed far above chance on this difficult sorting task (percentage accuracy = 38.7%, 18.8% above the chance level), potentially because higher demands in memory and reasoning incentivized strategic behaviors. Children also independently discovered at least two efficient algorithmic solutions to the sorting problem, Selection sort and Shaker sort. Additionally, our developmental results show that older children were more efficient sorters than younger children and used efficient sorting algorithms more frequently. These results demonstrate that children are

far more competent at applying algorithmic solutions to sorting tasks than previous research would suggest, and performance on sorting tasks improves throughout development.

## PA-20 Semantic content as belief state attribution?

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The nature of linguistic meaning is a pivotal question not only in philosophy or linguistics but in cognitive development as well, because it may hold the key to language acquisition. Here I argue for a novel approach to how meaning may be computed and acquired in infancy. The linguistic models of the past five decades have proposed an ever less direct linkage between linguistic form and content. While the code model idealized meaning to be directly carried by transmitted codes, the Gricean pragmatics tradition and its heirs suggest that, following some decoding, non-linguistic inferential mechanism yield content as intended meaning. Even though there is a broad agreement in the importance of communicative intentions, most researchers deem mentalization – the attribution of mental states to social partners – unnecessary for communication. Besides a non-mentalistic interpretation of intentionality, which has not been substantiated yet, this position places the inferential mechanisms necessary for meaning on a pragmatic level of language processing. Recent neuroscientific findings with preverbal infants show, however, that the semantic system is sensitive to mentalistic manipulations. Moreover, it is only the semantic system that responds in certain situations that involve only social-mentalistic but no semantic processing load, for example, to the mere presence of a social partner during object labeling. These results raise the possibility that the semantic system functions fundamentally mentalistically and that linguistic meaning is computed neither based on a code-table (i.e. mental lexicon) nor via extralinguistic inferential mechanisms but by the attribution of mental content to social partners. Such a perspective transforms Quine's gavagai problem from a linguistic-philosophical riddle of meaning into a challenge of mental state attribution – which seems far less mysterious or irresolvable. "What is meant" may not be carried by words or inferred from context but attributed as an intentional belief state (Forgács, 2024).

## PA-21 The effects of a social robot on persistence in 4-5-year-olds

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Children's persistence plays a crucial role in shaping their future success (Eskreis-Winkler et al., 2014). Recent studies have investigated ways to improve persistence through human interactions. However, with the rapid advancement of technology, social robots are becoming increasingly familiar to children and may assume roles similar to those of humans. In this study, we tested whether encouragement from a robot promotes children's persistence in the wooden box task, where children

are asked to open the box but are unable to do so (Leonard et al., 2020). To identify the significant factors influencing persistence, we established four conditions manipulated through child-robot interaction before the task (interaction/no interaction) and encouragement from the robot during the task (active/sill). After the persistence task, the children were asked six questions related to their perceptions of the robot and the task (e.g., "Does the Robot see things?", and "Did you enjoy?"). We examined the effects of the two factors and their interactions on the persistence and scores for each question. A total of 108 4–5-year-olds (mean age = 63.73 months, SD = 5.13, range = 48-71, 45 females) participated in this experiment and were randomly assigned to one of four conditions. A regression analysis revealed no significant main effect of the robot interaction ($\chi2(1) = 2.97$, $p = .08$) or the interaction between two factors ($\chi2(1) = .15$, $p = .70$), but there was a significant main effect of the robot's encouragement ($\chi2(1) = 11.12$, $p < .001$). These findings indicate that encouragement from robots is effective in enhancing children's persistence during challenging tasks. We discuss the mechanisms underlying the relationship between encouragement from the robot and persistence, considering children's behavior during the task (e.g., gaze and utterances), as well as their responses to questions about the robot and the task.

## PA-22 The Relationship between Eye-Contact, ToM, and Intelligence in School-Age Children

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As children develop, their ability to navigate the social world becomes increasingly complex, involving a nuanced interplay between eye contact, Theory of Mind (ToM), and cognitive abilities. Eye contact, a fundamental aspect of nonverbal communication, and ToM, the capacity to understand and attribute mental states to oneself and others, are essential components of social interaction. These elements are particularly significant in the context of Autism Spectrum Disorder (ASD), where difficulties with eye contact not only serve as diagnostic criteria but also offer a window into the deeper complexities of the child's social experience. This study explores how these aspects of social cognition interact and are influenced by cognitive factors providing insights into the social development of children across different cultural contexts. Six-to-nine year-old children completed three tasks: wearing eye-tracking glasses during a conversation, completing a ToM task, and two sections of the Wechsler tests focused on perceptual reasoning skills. Additionally, parents filled out the ASRS questionnaire to identify any ASD symptoms, which were analyzed alongside ToM and intelligence scores. Results revealed a positive correlation between ToM and intelligence ($n = 75$, $r = .45$, $p < .001$), indicating that ToM may involve broader cognitive abilities beyond social cognition, and the lack of strong correlation with ASD symptoms supports this hypothesis ($n = 75$, $r = -.05$, $p = .659$). We will further investigate the correlation between intelligence and eye contact and the potential role of gaze aversion as a cognitive strategy. These findings, along with the ongoing exploration of eye contact patterns, deepen our understanding

of the relationship between gaze aversion, ToM, and intelligence, and underscores the importance of considering cultural and cognitive contexts in the assessment of children's social development.

## PA-23 Understanding of the effects of forgiveness on transgressors among preschoolers

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Forgiveness plays a crucial role in restoring and maintaining cooperative relationships, enabling individuals to keep benefitting from them. Research indicates that forgiving behavior emerges as early as age four, both as a third party and a victim (e.g., Oostenbroek & Vaish, 2019). A prior study indicated that the understanding of the effects of forgiveness on victims' emotions and behavior develops during preschool years (Toda et al., 2024). However, their understanding of its effects on transgressors remains underexplored. This study focuses on four primary effects of forgiveness on transgressors: (1) increasing the transgressor's guilt, (2) fostering the transgressor's gratitude toward the victim, (3) preventing repeated transgressions, and (4) promoting prosocial behavior toward the victim. Four-, five-, and six-year-olds (N = 45 each) in Japan responded to stories in which a transgressor was either forgiven or not forgiven, along with 45 adults who participated in the study online. The study found that adults associate guilt with both forgiveness and unforgiveness, while children link guilt primarily to forgiveness. All age groups expected forgiven transgressors to express more gratitude than unforgiven ones, with six-year-olds anticipating higher gratitude levels than younger children. Adults believed that forgiveness reduced the likelihood of repeated transgressions, a distinction that children did not make. Regarding prosocial behavior, five- and six-year-olds, as well as adults, expected more from forgiven transgressors, while four-year-olds exhibited no significant difference between scenarios. These findings suggest that children's understanding of how forgiveness affects transgressors' gratitude and prosocial behavior begins to develop around age four and continues to develop through the preschool years, gradually aligning with adult perspectives. However, their comprehension of forgiveness's impact on transgressors' guilt and the likelihood of future transgressions may develop later. This study provides insight into the developmental process by which children learn how forgiveness influences transgressors and repairs damaged relationships.



## PA-24 Factors influencing children's relationship with voice assistants

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The use of voice assistants (VAs, which are artificial intelligence products) is rapidly increasing in children's environments, making it important to examine the characteristics of children's interaction

and parasocial relationships (PSRs) with these devices. This study investigated 8- to 10-year-old children's (N = 68, 33 girls; M = 109.79, SD = 9.68) interaction with a VA and the characteristics of the PSR established with the VA in comparison to children's PSR with their favorite cartoon characters, toys, and close friends. The findings revealed that children's PSR with a VA, after a single interaction, was on par with their PSR with favorite cartoon characters and toys. Further, there was a positive correlation between children's PSR with the VA and their attribution of agency, biological properties, and life to the VA, as well as their general tendency to anthropomorphize non-human entities (e.g., nature, animals, and technological devices). These relationships highlighted the intricate nature of children's conceptualization of VAs. How VA's affordances, such as allowing for reciprocal interaction, may have influenced this observation was discussed. Further, as expected, children's responses to PSR items, which measured PSR established with the VA via self-report, correlated with children's use of anthropomorphic language (e.g., mentions of the VA's emotions) during the interaction as a behavioral measure of anthropomorphic conceptualization of the VA. However, there was no relationship between the PSR measure and habitual polite phrases (e.g., hello, thank you) children used during the interaction, suggesting that using self-report and behavioral measures together is essential for capturing the complexity of children's conceptualization of VAs. Based on child reports, this study adds to our understanding of children's PSRs with traditional (i.e., cartoon characters and toys) and novel entities (i.e., VAs), contributing to our understanding of how children interact with artificial intelligence in social contexts.



## PA-25 Frontal theta modulation as an index of cognitive ability: A longitudinal study across the first two years of life

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The power of theta oscillations (~3 – 6 Hz) in infant EEG is linked to learning success in various tasks (Begus and Bonawitz, 2020). Notably, the extent to which infant frontal-central theta power is modulated by novel content has been shown to predict cognitive ability years later (Braithwaite et al., 2020; Jones et al., 2020). While theta rhythm modulation appears to be a promising candidate for a biomarker of early cognitive ability, its development over the first year of life had not been studied. Our longitudinal study examined the intraindividual stability of frontal-central theta modulation by novel content. EEG was measured in n = 132 infants at 6 and 12 months while they watched a short non-social video. At 24 months, we collected behavioural measures of cognitive development, including the Bayley-III scales and a selective visual attention task. We replicated the finding that frontal-central theta power increases over the course of video viewing, both at 6 and at 12 months. The reliability of the theta modulation index was good at 6 months, but only fair at 12 months. Theta modulation showed poor intraindividual stability, but decreased from 6 to 12 months on a group level. We argue that the observed pattern of results could be explained by the possibility that at 6 months, infant focused attention (as indexed by theta power) is more 'tuned in' to the video, while at

12 months endogenous influences on attention (and, consequently, theta power) play a greater role. The presentation will include additional analyses incorporating cognitive outcomes at 24 months.

## PA-26 Do 18-month-olds spontaneously understand novel iconic gestures?

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Both spoken and signed languages systematically use iconic forms to convey meanings (Dingemanse et al., 2015), facilitating communication without pre-existing conventions. Several theories suggest that iconicity plays a crucial role in language emergence and acquisition (Imai & Kita, 2014), yet evidence for comprehension of iconicity in the first two years is weak (Bohn et al., 2019; Fort et al., 2018; Namy, 2008). One possibility is that this ability develops gradually, raising questions about iconicity's role in language acquisition. Another is that prior studies may have obscured this ability by focusing on specific iconic associations (e.g., bouba-kiki effect, Fort et al., 2018) or using unsuitable comprehension measures for young children (Ambridge & Rowland, 2013; Bohn et al., 2019; Namy, 2008). To explore this, we adapted an intermodal preferential looking paradigm to test spontaneous comprehension of novel iconic gestures in French-learning 18-month-olds. We manipulated infants' experience with the gestural modality by having two groups: infants exposed to baby-sign (Acredolo & Goodwyn, 1996) and non-signer infants. Data collection is on-going (n=14 with 4 non-signer infants; expected completion date December 2025), thus, here we present the results of both groups combined. Preliminary results show that when tested on words, infants were more likely than chance to look at the target object, validating the unimodal protocol used for this study. However, they did not show a higher-than-chance tendency to look at the target object when they are tested on gestures or signs. This suggests that implicit looking-time measures are consistent with previously-used explicit measures, indicating that 18-month-olds' failure to spontaneously understand novel iconic gestures is not attributable to a methodological issue. Forthcoming analysis will elucidate whether this ability is consistent across signer and non-signer infants, expanding the literature on infants' sensitivity to iconicity and the role of early experience in language development.

## PA-27 Will chimpanzees use the naïve utility calculus to infer the value of novel food items?

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In the naïve utility calculus framework, Jara-Ettinger and colleagues (2016, 2020) showed that human adults and children implicitly assume that others act to maximize the outcomes of actions relative

to the expected costs. Nonhuman great apes face similar social challenges and may also use this heuristic to anticipate and interpret others' behavior in cooperative, competitive, and social learning contexts. While apes have been shown to predict others' behavior (e.g. Hare et al., 2000) and adopt novel food preferences (e.g. Shorland et al., 2019) it is unclear whether these predictions integrate rewards and costs, as usually only the former has been manipulated. We adapted a child study by Jara-Ettinger and colleagues (2015) to investigate whether chimpanzees use the naïve utility calculus to infer the value of novel food items through conspecifics' choices under varying effort conditions. In training, participants preferred a lower over a higher effort option when both were equally rewarded. Effort was manipulated as the number of straws that needed to be pulled out of a tube to release a reward. During the test, chimpanzees observed a conspecific in repeated forced choice situations between two novel food items. In the same food condition, the model always chose A over B. In the unequal effort condition, the model chose A when both were obtainable with equal effort, but chose B when A required a much higher effort. In the equal effort condition, the model chooses equally between the options that are always available under low effort. Subsequently, participants themselves choose between the novel food items. The naïve utility calculus predicts a decline in preference for A across the three conditions. Data collection is currently ongoing. Preliminary results suggest that while chimpanzees evaluate choice frequency, they do not account for the effort exerted by others to obtain these items.



## PA-28 Mother-child verbal and affective interactions during shared book reading: Effects of child gender

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This study aimed to examine whether the nature of mother-child interactions during shared book reading/ SBR varied with child gender and to examine the relation of the interactions to child learning outcomes. Sixty-one junior preschool children (33 boys; Mage=46 months) and their mothers read a word-less picture book together. Their verbal interactions (i.e., total utterances and total questions) and positive affection between mothers and children were recorded and coded. Mothers reported socio-economic status/ SES (indexed by maternal education and monthly income) and SBR quantity at home (indexed by reading frequency and reading duration). Children's cognitive and vocabulary outcomes were tested individually. One-way ANCOVA revealed that mothers asked daughters significantly more questions than sons, with SES as a covariate (as is shown in Table 1). Furthermore, hierarchical regression analysis demonstrated that controlling for SES, child gender accounted for 6.7% of the variance in parental questions. Partial correlation analysis indicated that controlling for SES, increased SBR quantity was positively correlated with better child cognitive performance, no matter for boys or girls. Moreover, more maternal speeches and parental questions were positively correlated with more child speeches. Nonetheless, boys and girls were different in some aspects: (a) increased SBR quantity positively correlated with boys' higher vocabulary scores instead of girls; (b)

higher positive affection was positively associated with more maternal speeches to boys and boys' verbal interactions (both total utterances and questions), while it was only significantly related to more parental questions to girls. See Tables 2 and 3 for more details. To conclude, gender difference exists in mother-preschooler shared reading, especially in their verbal engagement and positive affection. The study is important in that it increases understanding of the connection between parent-child verbal and affective interactions and individual differences during SBR practices and its relation to child development.

## PA-30 Collaborative cheating: A Developmental Study

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Collaboration is a key aspect of human social interaction. From a young age children are motivated to collaborate on tasks in which joint success depends on both interaction partners (e.g., Grueneisen et al., 2015; Hamann et al., 2012). Although collaboration has many positive implications for individuals and groups, research with adults shows that collaborative tasks can encourage dishonest behavior like cheating (Weisel & Shalvi, 2015; Leib et al., 2021). However, little is known about whether collaborative cheating is also evident in young children. We investigated if children, similar to adults, cheat more in a collaborative context, compared to an analogous control setting. In a preregistered study, dyads of 5- to 8-year-old German children (N = 80) were randomly allocated to either the collaboration or a control condition. All dyads played eight rounds of a die-rolling game in private. In the collaboration condition, dyad partners' success depended on each other: children won a prize only in rounds in which both reported a double. In the control condition, children won a prize if they reported a double, regardless of their partner's report. We hypothesized that children would be more likely to cheat by overreporting doubles in the collaboration condition than in the control condition. Results revealed high cheating rates in both conditions: Children reported about 3 times as many doubles as expected by chance (chance comparison: $t(41) = 9.46$; $p < .001$), and cheating increased as the game progressed (trial effect: $\chi^2(1) = 25.93$, $p < .001$). However, there was no evidence of increased cheating rates in the collaborative setting compared to the control setting (condition effect: $\chi^2(1) = 0.0004$, $p = .984$). In a second study, we are currently investigating whether children engage in collaborative cheating in a sequential task which is hypothesized to emphasize game partners' mutual dependence more strongly.

## PA-31 The short-term effect of video gaming on the visual process of a picture story: An eye-tracking study

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Picture stories offer insights into the development of eye movements necessary for reading in pre-reading children (Arizpe, 2014). As children mature, their visual scanning of picture stories increasingly follows a Z-path pattern, moving from left to right and top to bottom (Zhang & Olivier, 2018). However, the fast-paced and diffuse nature of popular video games may influence how visual sequences are processed (Hilla et al., 2020). Our study aimed to investigate the short-term effect of video game play on the visual processing of a picture story by examining the impacts of stimulus features (diffuse/linear) and platforms (digital/non-digital). Using an eye-tracking experiment, we compared the visual scanning of a picture story by 1st graders (N = 71) and 5th graders (N = 71) following a 10-minute exposure to (1) a video game featuring diffuse stimuli on a tablet (2) a paper-and-pencil line pattern tracking task or (3) a line pattern tracking task on a tablet. The visual scanning patterns were evaluated on a 1-5 scale by two independent raters. Additionally, information on children's video gaming and reading habits was collected via a questionnaire. Our findings revealed no significant short-term effect of video game exposure with diffuse stimuli on the visual scanning of the picture story in either age group. Among 1st graders, there was a positive relationship between regular reading habits and Z-path scanning of the picture story. In 5th graders, we identified a negative correlation between video gaming time and Z-path scanning of the picture story. Although longer video game exposure might be necessary to detect short-term effects, our results suggest that video games requiring rapid, non-linear eye movements may interfere with the sequential eye movements needed for reading, potentially altering the way visual sequences are processed over time (Chang et al., 2017).



## PA-32 Investigating the impact of preterm birth on Theory of Mind development in five-year-old children

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Theory of Mind (ToM), the ability to reason about others' mental states, is crucial for social interactions and understanding. Social cognition may be impacted by preterm birth (Dean et al., 2021) –

perhaps due to altered early social experiences in the NICU. Behavioural research finds delayed ToM development following preterm birth in 3–4-year-old children, but evidence concerning older children is inconsistent (Marleau et al., 2021; Witt et al., 2018). Additionally, most ToM behavioural tasks involve language, attention, and executive functions, which are also impacted by preterm birth – making it difficult to discern whether atypical performance on ToM tasks reflects differences in ToM development per se versus development of these other cognitive capacities. To test for domain-specific differences in ToM development as a function of gestational age (GA) in a sample of preterm (n=41, GA: 24-31.9 weeks) and term born (n=45, GA: 36.4-42 weeks) 5-year-olds, we used behavioural and movie-viewing neuroimaging measures. We collected functional MRI data while children watched a short silent movie (Richardson et al., 2018). Afterwards, children completed an age-appropriate linguistic behavioural ToM task (Sotomayor-Enriquez et al., 2023; https://osf.io/G5ZPV/) which involved listening to an experimenter tell stories containing various ToM concepts and answering 45 questions about the characters' mental states. In a linear regression across the full sample (n=86), higher GA correlated with better ToM task performance ($B=0.27$, $t=2.81$, $p<0.01$), accounting for receptive language ($B=0.43$, $t=4.43$, $p<0.001$) and test age ($B=-0.03$, $t=-0.37$, $p=0.71$). Executive functions and attention did not differ by GA ($p>0.1$). In ongoing analyses, we test the neural underpinnings of reduced ToM scores in children born preterm. If GA has a direct effect on ToM development, then we should observe atypical/delayed development in ToM brain regions.



## PA-33 Understanding online cheating behavior in 5-Year-Olds: The impact of proctoring limitations

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The coronavirus disease (COVID-19) pandemic has significantly increased the utilization of online communication, leading educational institutions to transition from in-person to virtual classes and exams. Jank et al. (2021) indicated higher rates of cheating in online university exams compared to traditional, face-to-face exams. This disparity is attributed to the limited visibility of online proctors compared to their in-person counterparts, making it easier for students to cheat undetected. However, it is unclear whether this tendency to cheat extends to young children and whether they grasp the limitations of online proctors' vision. The present study aimed to explore (1) young children's understanding of online proctor's visual limitations and (2) whether online settings encourage cheating behavior. Seventy-four 5-year-olds (34 girls) were administered a challenging math test with a cheat sheet placed on the table. The participants were instructed not to look at the cheat sheet and were divided into two groups: an offline group, where children were monitored in person by an experimenter, and an online group, where monitoring was conducted virtually. While the offline proctor could see the cheat sheet, the online proctor could not. Following a test to assess their understanding of the proctor's visual field, results exhibited that children recognized the offline proctor's ability to see the cheat sheet, but were uncertain about what the online proctor could see. Many children mistakenly

believed that the proctor could view the area between themselves and the monitor, which was not visible. Cheating occurred more frequently in the online setting than in the face-to-face scenario. These findings suggest that online environments may promote cheating among 5-year-olds as a result of their awareness of the limitations of online proctors' vision, highlighting the developmental roots of online cheating behavior.

## PA-34 Flexible trust: The role of conflicting cues in children's partner selection

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Much of what we learn and do, especially as children, depends on others, making it crucial to be selective and efficient in choosing whom we cooperate with and learn from. Even preschoolers can recognize domain-specific competencies and prefer partners whose knowledge and skills are most relevant to the task at hand(Hermes et al., 2016). Previous literature also shows that children adjust their reliance on different agents depending on their goals(Grueneisen et al., 2023). However, the mechanisms that support children's partner preferences and selective learning are still unclear. The current study examines whether and to what extent children adapt their partner selection based on the characteristics of the agents and the problem at hand. In a within-subjects design, 3- to 7-year-old children (planned n=120) are presented with two trials. First, in the One-cue-trial, they encounter two agents, one is knowledgeable and the other is not. Following, children are presented with two sets of scenarios: (1) obtaining information, and (2) choosing a partner. During the obtaining information phase, children are presented with (1) a competence-relevant nonsocial context; and (2) a competence-irrelevant social context. Afterward, children choose which agent's answer to endorse. In the partner preference phase, children are asked to choose one of the agents as a partner for a (1) competence-required-situation; and (2) for a situation that is social and does not necessarily require competence. In the Two-cues-trial, children are introduced to a second characteristic, helpfulness, with the knowledgeable agent being unhelpful and the unknowledgeable agent being helpful. The process mirrors the One-cue-trial but with the added contrast between competence and helpfulness. Preliminary data (n=76), however, suggest that around the age of 6, children strategically select their partners on the basis of the relevant characteristics in the relevant situation. Data collection is ongoing and expected to conclude before the conference.

## PA-35 Can young children spontaneously generate adaptive information-search strategies?

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By age three, children can already recognize the statistical features of their learning environment and adapt their learning strategies accordingly (Ruggeri, 2022). However, it remains unclear whether young children can generate (cf. merely identify) efficient adaptive information-search strategies from scratch. In the current study, we tested the emergence of children's ability to generate adaptive information-search actions and explored the potential sources of their suboptimality. We presented 3-to-7-year-old children with a non-verbal information-search task analogous to the traditional 20-questions game, in which participants ask yes/no questions to identify a target object. In our paradigm, the children's task was to identify an object's location among a set of 16 possible locations as fast as possible (e.g., "On which planet did Toma forget his keys?"), by either generating search queries themselves (Generation condition) or by choosing between two provided search alternatives (Selection condition). Across two within-subject trials, we manipulated whether the target was more likely to be found at some locations than others (Skewed trial) or was equally likely to be found at any location (Uniform trial). Based on previous work (e.g., Ruggeri et al., 2017), we predicted that even the younger children would adapt their information-search strategies and choose maximally informative queries (e.g., varying the number and identity of locations included in a query) as a function of the trial hypothesis space in the Selection condition. Relative to this, we speculate a relatively protracted developmental trend in the more demanding Generation condition. Moreover, we aim to characterize the source of developmental differences, such as younger children failing to weigh hypotheses by their likelihood or mistakenly maximizing the probability of positive feedback rather than informativeness. The piloting for the study is underway, and data collection (N = 120) will be completed in December.



## PA-38 Self-initiated encoding and object-location memory: Differences and similarities between children and adults

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During development children learn the regularities that govern their environment, knowledge that benefits memory for information that aligns with these regularities (Brod et al., 2013). Knowledge on the locations on objects within natural scenes is an example of such regularities that children acquire (Ohlschlager & Vo, 2020). In the current study, we explored how children utilize scene knowledge to place objects in natural scenes, in locations that they later memorize. We termed this aspect of memory, self-initiated (SI) object-location memory. Twenty-four young adults and 24 children (aged 8-10 years) memorized the locations of pictures of real-world objects embedded in pictures of indoor

scenes, under three encoding conditions: in the self-initiated (SI) condition participants selected the locations of the objects they memorized; in the SI and elaboration condition participants selected the objects' locations and elaborated on the strategies guiding their selections; and in the provided condition participants memorized locations selected by the computer and provided to the them. Overall, participants viewed 12 indoor scenes (e.g., kitchens, bathrooms). Each scene was presented four times with four different objects, two consistent with the scene and two inconsistent (e.g., a coffee jar in the kitchen or a towel in the kitchen). Following a 30-minute delay, participants retrieved the locations of the objects they encoded. The results showed similar accuracy levels across age groups, and comparable benefits from self-initiated encoding. Additionally, children used deep encoding strategies as frequently as young adults, primarily placing objects based on spatial regularities and the objects' function. However, compared to young adults, children relied more on the object's function rather than spatial regularities. Overall, the results demonstrate mature ecological self-initiated object-location memory in late childhood.

## PA-39 The detection of configuration and identity changes of object arrays in infancy

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Abstract relations (e.g., hierarchies, causal connections) are often depicted by spatial arrangements of symbols. This study tests the hypothesis that infants are more likely to encode spatial relations among objects when they are interpreted as elements of a symbolic display. Testing this hypothesis requires contrasting (symbolic) displays to (non-symbolic) scenes. Here, we posit that infants are more likely to interpret objects as playing the role of symbols if someone is displaying ostensive communicative signals while manipulating them. We test 10-month-old infants using a between-subjects design. Infants watch videos of an actress manipulating three identical, unfamiliar objects arranged in various spatial configurations (e.g., an equilateral triangle, a horizontal line) in one of two conditions. In the communicative condition, the actress displays ostensive communicative signals while arranging the objects: she is facing the infant and establishing eye-contact at the beginning of each trial, before putting each object in place, and at the end of each trial. In the non-communicative condition, the actress arranges the objects on the table without such cues (making no eye-contact, her body oriented away from infant). At test, to investigate which aspects of the object arrays infants encode, we present them with two displays side by side, each representing a change from the familiarization array in spatial configuration, object identity, or both. Our dependent variable is proportional looking to each of the displays, measured using a preferential looking paradigm. We expect infants to look more toward changes of configuration in the communicative condition than in the non-communicative condition, indicating preferential encoding of spatial arrangements when the objects are potential symbols. Data collection is ongoing.

## PA-40 Cross-cultural investigation of responses to baby-schema: A study of small-scale Malaysian and an urban Germany community

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The concept of baby-schema proposes that specific physical features of babies, most prominently, age-specific facial morphology, elicit complex human caretaking responses. This response was proposed to be innate and automatic in all humans, irrespective of experience (parental status, age). Furthermore, non-human agents (dolls, animals) with similar features could activate this human care-taking response. Since this original proposition by Konrad Lorenz, the responsiveness of human adults and children to the baby schema in facial features of human infants has been repeatedly demonstrated with participants from large-scale communities in the Global North. Further, research in the same communities has shown that adjusting animal facial features to human baby-schema configurations elicits similar behavioral responses. However, no prior study has investigated responses to baby-schema facial characteristics in communities that differ distinctively from urban large-scale communities in the Global North. The present study tests this gap by comparing responsiveness to baby-schema in two small-scale communities in Malaysia (the contemporary hunter-gatherer Batek and the slash-and-burn-farming Temiar) and an urban reference sample from Leipzig, Germany. Participants engaged in a screen-based preferential-looking task (eye-tracking) and a Two-Alternative-Forced-Choice-Task (2AFC-Task) featuring highly controlled facial stimuli of infants exhibiting varying levels of baby-schema (Borgi et al., 2014). We presented participants with pairs of facial images of the same human infant or cat infant (species effect), with each pair manipulated to have high vs low facial baby-schema (baby-schema effect), respectively. In the eye-tracking study, all image pairs were additionally presented inverted (orientation effect) as a control condition, mitigating potential low-level visual effects. After the eye-tracking task, participants were instructed to make evaluative decisions about preference, cuteness, age, and health for each image pair in the 2FAC Task. Data collection for the Malaysian samples is complete and German data collection is ongoing. We will present results of all samples at the BCCCD.



## PA-41 Development of gesture-use in infants aged 12 to 18 months

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Gestures accompanying speech (co-speech gestures) are crucial for communication (Kendon, 2004) and fall into four types: deictic (e.g., pointing), iconic (e.g. pretending to sip from a glass when uttering “do you want water?”), symbolic (e.g., thumb up), non-referential (rhythmic movements during conversation) (Bavelas et al., 1992; McNeill, 1992). How do these gestures develop during infancy? While deictic gestures are well-studied, the existence of other gesture types before speech

emergence is debated. We applied an ethological method from nonhuman primate gesture studies (Hobaiter & Byrne, 2014) to analyze spontaneous gestures in infant-caregiver interactions. We manually annotated 31 hours of video from CHILDES (Demuth & Tremblay, 2008; Morgenstein & Parisse, 2012) to describe gesture forms, types, and functions in six infants (12-18 months). The repertoire consisted of 62 gesture forms, categorized into the 4 types used by adults. Deictic and iconic gestures had more semantic functions, while non-referential gestures had more pragmatic functions (Gupta et al., in review), mirroring adult co-speech gestures. We are currently analyzing how gesture frequency changes around word production and how pre-speech gestures align with vocalization/speech. Preliminary findings show that deictic and non-referential gestures are more frequent than iconic and symbolic gestures in the pre-speech stage, suggesting an early development of object-focused communication and social interaction, to be followed by increased iconic and symbolic gestures after speech onset (Özçalişkan et al. 2014). Additionally, long, continuous vocalizations overlapped more with non-referential gestures, while short vocalizations overlapped with referential gestures, similar to how non-referential co-speech gestures align with speech prosody and referential ones with words. Our results suggest linguistic properties in pre-speech gestures, indicating they may be precursors to co-speech gestures. Ongoing analyses will document gesture-use in these infants until 36 months of age.



## PA-42 An alternative developmental path toward language in autism

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Recent findings (Kissine et al., 2023) highlight that language development in autistic children diverges from neurotypical patterns, with joint attention levels prior to oral language development not predicting outcomes in autism. Despite these differences, most autistic children develop functional oral language, pointing to alternative pathways of language acquisition, for example through an early interest in written language. This presentation will discuss results from two studies investigating the frequency and nature of this interest in a large cohort including all 701 children (391 autistic, 310 non-autistic) aged 2-6 who were referred to an autism assessment clinic over four years. Their interest in letters and numbers was coded from assessment reports with a high inter-rater reliability (Kappa > 0.9). Ordinal logistic regressions assessed the relationship between diagnosis and interest in letters and numbers. The parents of 138 autistic and 99 non-autistic clinical children, as well as 76 typically developing (TD) children, completed a questionnaire about their child's interest in letters and numbers, its manifestations, parental attitudes, and the child's oral language. Cox proportional hazards models analyzed the age of interest emergence, and linear regression assessed the connection between diagnosis and standardized index scores of interest. An inductive thematic analysis was conducted on qualitative data. Findings revealed that 37% of autistic children exhibited an intense or exclusive interest in letters, even if 76% of them were minimally speaking. The odds of this interest were

significantly higher in autistic children (letters: OR = 2.78; numbers: OR = 3.49), regardless of their oral language level. Notably, the age of interest emergence was similar between autistic and TD children but manifested differently, with non-autistic children showing more social engagement. These results suggest that a strong interest in written material may indicate an alternative pathway for language acquisition in autistic children, especially those with limited oral language.

## PA-43 Ecological factors influencing partner choice

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Previous research suggests that partner choice decisions are based on partners' perceived characteristics, such as prosociality or competence. Recent studies indicate that children as young as age 5 take into account partners' characteristics when making partner choice decisions. Crucially, however, the usefulness of partners' characteristics depends on the incentives inherent to a given ecology. How children interpret and weigh their potential partners' characteristics across different environments remains unclear. In this study, we test whether 5- to 9-year-old children (planned n=100) selectively choose partners based on the characteristics that, in a given environment, would yield a greater expected benefit. We use a tablet-based foraging game in which children observe and interact with animated agents ("Kobos") that differ in their helpfulness and skill - skilled Kobos are always relatively unhelpful, and helpful Kobos are always relatively unskilled (Schlingloff-Nemecz, Stavans & Csibra, 2022). Critically, we manipulate the environment's benefit distribution, so that benefits are either always shared between the participant and the Kobo ('shared benefit condition') or always individually awarded ('own benefit condition'). We predict that children will choose the partner who would yield the most benefits in a given situation, selectively prioritising certain partners' characteristics depending on the ecological constraints of the environment. Thus, when facing an environment where a partner can altruistically yield benefits for them ('own benefit condition'), children will choose the relatively more helpful partner. Instead, when facing an environment where both players obtain mutualistic (shared) benefits ('shared benefit condition'), children will choose the relatively more skilled partner. Data collection is still ongoing (currently n=76), and we expect to present the final results at the conference. Preliminary data, however, suggest that older (8 year-olds) but not younger children strategically select their partners on the basis of the most relevant trait within their assigned environment.

## PA-44 Developmental progression of anthropomorphism and its relation to nonliteral language use

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People tend to overextend humanlike characteristics such as emotions, and intentions to non-human entities, which is known as anthropomorphism (Waytz et al., 2010). Anthropomorphic thinking is observed from infancy to adulthood, however, the findings on the developmental progression are inconsistent (Piaget, 1929; Severson & Lemm, 2016). This study aimed to investigate the developmental progression of anthropomorphism in preschool, school-aged and adult samples. Furthermore, to explore the weak and strong forms of anthropomorphic thinking, for the first time, this study investigated the relation between anthropomorphism and the use of nonliteral language. 84 preschool-aged and 77 school-aged children, and 147 college students completed two different anthropomorphism tasks (i.e., movie narrative measure and interview measure) and a metaphor task (i.e., preference for and use of metaphors). School-aged children's and adults' movie narratives had more anthropomorphic elements compared to preschoolers'. Furthermore, adults had higher scores than the two child groups in the interview measure. The two anthropomorphism measures were correlated with each other in adults but not in children. Finally, positive links were observed between anthropomorphic narratives and metaphor use in adults, and interview measure and preference for metaphors in school-aged children. In sum, we provided evidence for an age-related increase from preschool to school years in the movie narrative measure, and from childhood to young adulthood in the interview measure of anthropomorphism, indicating that anthropomorphic thinking may strengthen over time. Furthermore, we provided some preliminary evidence for links between anthropomorphism and preference for a non-literal language style. The tendency for older children in our sample to better understand and prefer metaphors may explain the age-related increase in narrative measure of anthropomorphism. Finally, children and adults favoring metaphors may be more inclined to anthropomorphize non-humans in their expressions, as both involve using figurative, imaginative and expressive language that attributes human-like traits to non-human entities.



## PA-45 The role of spatial information in arithmetic learning

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Arithmetic skills are foundational for later math learning. In particular, the use of advanced arithmetic strategies, such as decomposition, predicts future achievement even after controlling for accuracy (Geary, 2011). The present study examined potential benefits of using spatial cues in arithmetic instruction for the acquisition of the decomposition strategy. The association between spatial and numerical reasoning has been primarily established with measures of accuracy. Yet, spatial cues may also affect the use of strategies because they facilitate numerical magnitude knowledge (Siegler

& Ramani, 2009), which is required to execute decomposition. Better spatial skills are associated with the use of advanced arithmetic strategies (Laski et al., 2013). The current study tested this relation experimantally. We hypothesized that incorporating spatial cues to numerical magnitude into instruction would increase frequency and accuracy of using decomposition strategy. US first-graders (N=194) were randomly assigned to conditions that varied only in the materials used for training: "Spatial-Continuous" where numerical magnitude was conveyed through length, "Spatial-Discrete" where numerical magnitude was conveyed by discrete units, and "Control" where materials did not contain spatial cues to numerical magnitude. All conditions involved eight 30-minute training sessions focused on the use of decomposition strategy for arithmetic problem-solving. Pre- and posttests assessed frequency and accuracy of using decomposition. The results showed spatial cues benefited arithmetic learning, but the effect was moderated by child's sex. Boys improved most in the Spatial-Continuous condition and girls in the Spatial-Discrete condition. This pattern was observed in both the frequency of using decomposition and accuracy. The results demonstrated a causal effect of incorporating spatial cues in arithmetic instruction, which has implications for the design of mathematics curriculum. The interaction between sex and the type of spatial cues that optimize learning calls for further research into mechanisms underlying the sex differences in the effects of intervention.

## PA-46 Exploring children's naturalistic social interactions using wearable cameras and machine learning

Nele-Pauline Suffo[1], Pierre-Etienne Martin[2], Daniel Haun[2], Manuel Bohn[1,2]

[1]Leuphana University, Germany; [2]Max Planck Institute for Evolutionary Anthropology, Germany



Direct insights into children's day-to-day experiences are limited despite their importance for development (Rogoff et al., 2018). Conventional methods, like laboratory play sessions, provide only superficial approximations of naturalistic experiences. The advent of wearable recording devices, allows for capturing experiences more comprehensively in children's home environments. However, the resulting data volumes are challenging to code with traditional methods. To address this, we introduce a data-driven approach using machine learning and computer vision algorithms to analyze children's everyday interactions. Children wear a vest equipped with a small camera that records video and audio, capturing unstructured, naturalistic experiences at home. Videos recorded from 03/2020 to 03/2024 capture the daily lives of 64 children (aged 3 to 5) from Leipzig, Germany, resulting in 162 hours of footage. Additionally, we collected data from the same age groups in kindergarten, providing a comprehensive view of their daily experiences across different settings. Our first goal is to approximate social interactions between the (key) child wearing the camera and others in their environment. We fine-tuned a pre-trained convolutional neural network for object detection (Redmon et al., 2016) to identify individuals other than the key child in the video data. Preliminary analysis suggests that children spend most of their time alone or with just one other person. Developmentally, the proportion of frames with no additional people detected increased from 63.88% in the 3-4 years

group to 70.39% in the 4-5 years group, then decreased to 65.39% in the 5 years and older group. Next, we develop a tracking solution (Du et al., 2022) to measure how long specific individuals remain in the child's view, aiming to better understand the dynamics of children's daily interactions. Taken together, our approach leverages machine learning to extract insights from a unique dataset, offering a naturalistic perspective on children's social interactions and development.

## PA-47 Corrective behavior in reciprocal contexts: Insights from Arab and Jewish children

Lena Kabha, Avi Benozio

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Distinguishing between 'guilt,' 'shame,' and 'regret' can be challenging (Liyanage & Usoof-Thowfeek, 2023; Uprichard & Mccormack, 2019). Here, we focus on the emergence of 'corrective behavior', defined broadly as actions taken to amend previous decisions. Our objectives were: to assess corrective behavior in reciprocal contexts, where it is most relevant (Vaish & Hepach, 2020); and to explore if this behavior varies with certain types of partners, particularly favoring in-group over out-group members. The sample included children from two 'real' social groups: Arab and Jewish (N=128; Mage=5.6; 50% Arab). The procedure involved a one-shot, costly, and sequential reciprocal task adapted from Benozio et al. (2024). First, an unidentified, age- and gender-matched partner made egalitarian distributive choices toward participants. Participants then responded by choosing either an egalitarian distribution or a selfish one. Finally, the partner's group membership was revealed, and participants had the opportunity to maintain or change their initial response. Results indicated that children evaluated the partner's egalitarian behavior positively, yet 80% of the initial responses toward such unidentified partners were selfish rather than reciprocal. A Generalized Linear Model analyzed 'corrective behavior' with predictors including participants' Initial response, Gender, Ethnicity, and partner's Group membership. A 2-way interaction was found between children's Initial response and Group membership ($\chi^2(1)=6.95$, $p<.01$), indicating that decisions changed from egalitarian to selfish twice as often when the partner was an out-group member. Another 2-way interaction was found between children's Initial response and Gender ($\chi^2_{(1)}=3.78$, $p<.05$), showing that girls were twice as likely than boys to change their decision from selfish to egalitarian. These findings reveal two distinct manifestations of 'corrective behavior': one involves retreating from an initially egalitarian response, particularly towards out-groups, while the second reflects a corrective adjustment aimed at enhancing reciprocity, especially among girls.

## PA-48 Third party evaluation for over-helping in preschooler

Momoka Sakaguchi, Hiromichi Hagihara, Yasuhiro Kanakogi

Osaka University, Japan

While children prefer helpers from an early age, helping behaviors are not always evaluated positively. For instance, preschoolers view helpful behavior negatively if this is associated with immorality, such as helping transgressor who try to destruct others works (Myslinska Szarek et al., 2023). This study focused on another form of negatively evaluated help: over-helping, which adults perceived negatively (Ryan et al., 2006). We examined whether children also evaluate over-helping negatively, by investigating changes in their evaluations, depending on the amount of helping. We conducted an experiment with 5-6-year-old preschoolers (N = 51, M = 73.0 months), as well as an online survey of adults (N = 50, M = 23.2 years). Participants were presented with a story in which a recipient in need of help and three other characters with varying responses: one who did not help (No-helping), one who provided an appropriate amount of help (Helping), and one who provided excessive help (Over-helping). Participants rated their preference for each character (Dislike to Like on a 7-point Likert scale), estimated the recipient's feelings (Unhappy to Happy on a 7-point Likert scale), and evaluated the amount of help (Less, Good, or Over). Preschoolers rated over-helping as positive and estimated the recipient's happiness equivalent to as they received appropriate help. Conversely, adults rated over-helping negatively and perceived the over-helped recipient to be as unhappy as the non-helped one. Both preschoolers and adults correctly evaluated the amount of help (No helping = Less, Helping = Good, Over-helping = Over). These findings suggest that while preschoolers recognize over-helping as excessive, they evaluate the over-helper as positively as the helper. Furthermore, preschoolers do not perceive a negative impact of over-helping on recipients' feelings. In summary, negative perception of over-helping might develop after preschool years.



## PA-49 Did some or all balls explode? An investigation of infants' understanding of quantifiers

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Quantifiers like "some" and "all" establish relationships between sets, expressing general thoughts about quantities. Despite much linguistic variation, they are among the most crosslinguistically stable (Keenan, 2012). Evidence suggests that they emerge early in language evolution (Kokab et al, 2022; and that toddlers show a basic understanding of quantified expressions (Barner et al, 2009), though a full comprehension (extending to e.g., the implicatures associated with some/all) develops over time (e.g., Noveck, 2001). We extend this research by investigating pre-linguistic children, a relatively under studied area of inquiry, with few exceptions (e.g., Téglás, 2009). To examine whether analogs to "some" and "all" may exist in 12-month-old infants (n = 24, mean age = 12;23, range = 11;09 -13;30), we familiarized them with scenes in which a big ball collides with several small balls (in

a number always exceeding object representation limits), causing a variable number, but never all of them, to explode. After 4-10 familiarization videos, an "All" condition video showed all the small balls explode after collision, and a "Some" video showed a novel proper subset exploding, with order counterbalanced. After two iterations of this sequence, infants saw a control "None" condition where no ball exploded. Infants looked longer at the last frame of the videos in the None and All, compared to the Some , conditions (Wilcoxon tests, p's<.05). Temporal pupil dilation analysis also showed a systematic change between conditions at 1.3-2.5 s after the contact, suggesting less processing effort in the All and None condition (two-tailed nonparametric permutation tests). These findings indicate that prelinguistic infants may spontaneously generate quantified representations. They also suggest that familiarizing infants with "All" videos and testing them with "Some" should reverse the pattern (longer looking and less engagement to "Some" videos), a prediction we are currently testing.

## PA-50 Studying the influence of cue modality on object memory during observed joint attention: eye contact, touch, and physical proximity

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Traditionally, joint attention has been operationalized based on visual cues, neglecting physical modalities of interpersonal connectedness. This project aims to expand this view by exploring physical cues of jointness, particularly within the context of observational learning. Specifically, we investigated whether and when in ontogeny infants can infer third-party joint attention based on touch and proximity, without eye contact. Two samples of 9- and 18-month-old German infants (N=32 each) were tested in a screen-based object encoding task showing videos of two women looking at a toy-like object (familiarization phase). The scenes varied regarding the presence of eye contact between the actors (yes, no) and their mutual touch in physical proximity (yes, no). As the dependent variable, we used infants' object encoding, measured via their novelty preference in a recognition test featuring the previously familiarized object next to a novel object. We found that 9-month-olds showed higher object encoding in conditions involving eye contact compared to conditions without eye contact (main effect eye contact: $\chi^2(1)=10.82$, p=.001, estimate=.29, SE=.09). In contrast, 18-month-olds exhibited higher encoding across all conditions involving jointness (via eye contact, proximal touch, or both) compared to a parallel attention condition lacking interpersonal connectedness (eye-contact x touch interaction: $\chi^2(1)=10.34$, p=.001, estimate=−.54, SE=.17). This suggests that German infants primarily rely on visual cues to recognize third-party jointness and that, with increasing age, their cue repertoire expands to incorporating physical modalities, too. We will discuss the implications of our findings in the context of within- and across-cultural variation in how human infants connect with and learn from others. Moreover, we are planning to give an outlook on preliminary results from a follow-up study, comparing German toddlers with chimpanzees in their

ability to recognize joint physical attention, and their tendency to use it as a relevant dimension when encoding objects in observed social interactions.

## PA-52 Does context matter for children's tool innovation? Comparing structured problems and play

Nicola Cutting, Darcy Neilson

York St John University, UK

Innovating simple novel tools such as pipe cleaner hooks has been shown to be extremely difficult for children under the age of 8. Children's lack of innovation and creativity in these tasks appears at odds with the imaginative, creative play observed in children. In artificial task environments, children are tasked with working individually on very structured problems, with short time limits imposed. Real-world innovations are unlikely to unfold in this way. They are likely to take time, be the product of collaboration and occur naturally rather than in a test situation. This study compared capacity for innovation and measured creative behaviours in structured (formal task) and non-structured (play) environments. Children aged 4 to 7 (N=120) participated in pairs to facilitate play behaviour and collaboration. Pairs were presented with two sets of apparatus/materials/toys presented in either a play context, e.g., 'Here are some things you can play with', or as a structured task, e.g., 'Can you retrieve the treasure?'. Pairs were given 10 minutes to interact with each set of apparatus. Children were extremely problem focused. Once the reward was discovered they persisted in trying to solve the problem (i.e., retrieve the object) in both the structured task condition and the play condition, even when they were not tasked with solving the problem in the latter. This resulted in no difference in innovation rates and time to success between the play and structured conditions (lowest $p = .110$). Children's creative and exploratory behaviours during the tasks were coded using the Analysing Children's Creative Thinking (ACCT) Framework (Robson & Rowe, 2012). Successful children in both tasks engaged in more exploration, involvement and persistence (all ps <.001), suggesting that in this study individual differences in children's approaches to tasks were more important than the context in which the tasks were presented.



## PA-53 Do children and adults think that knowledge is justified true belief? A test of Gettier cases

Saba Amirhaftehran, Marina Proft, Hannes Rakoczy

George August Universität Göttingen, Germany

Theory of Mind is our capacity to ascribe subjective mental states to others and ourselves. Regarding the ascription of cognitive states, the long-standing consensus in philosophy has been that belief is the primary propositional attitude. However, the belief-first account has faced challenges, tracing back to Edmund Gettier. After many unsuccessful efforts to add an element to the JTB definition,

the "Knowledge First" slogan, positing knowledge as a fundamental epistemological concept, has gained traction. As philosophical debates about the nature of knowledge and belief provide a foundation for understanding their attribution and role in action prediction, the knowledge-belief primacy controversy is relevant to ToM literature. However, Gettier cases have not been adequately addressed in a developmental context. In the current study, we aimed to systematically examine knowledge attribution and its role in action prediction by employing a child-friendly design of Gettier cases adapted from the standard ToM task. Participants watched puppet show videos where a protagonist witnessed an object being placed in one of two boxes. In the Knowledge condition, the protagonist saw the object moved and returned to its original location. In the False-Belief condition, the protagonist was absent while the object was moved to the other box. Additionally, two Gettier cases were introduced: In the Gettier-transfer case, the object was moved but returned to its original location, and in the Gettier-identical case, the object was replaced with an identical one, both in the protagonist's absence. After watching each video, the participants were asked knowledge and action-prediction questions (adults in the same experiment, and children aged 5–8 in two separate studies). Data collection is ongoing, but preliminary results show that both groups share Gettier intuitions.

## PA-54 Unveiling early connections: Analysing parent-infant interactions at 1 and 5 months with Datavyu and DeepLabCut

Zayna Mian[1], Laura Carnevali[2], Staci Meredith Weiss[1], Mark Henry Johnson[1], Sarah Lloyd-Fox[1]
[1]University of Cambridge, UK; [2]University of Padova, Italy



This study, part of the Perinatal Imaging Project in Partnership with Families (PIPKIN), investigates the use of manual coding methods like Datavyu alongside AI-driven machine learning software such as DeepLabCut to quantify specific touch and gaze behaviours within parent-infant interactions. These interactions are critical to infants' socio-emotional development and functional brain connectivity (Feldman, 2007; Ilyka et al., 2021). We aim to track mutual gaze, affective and affectionate touch to assess their consistency and changes from 1 to 5 months as infants' social and motor skills develop. By comparing the effectiveness of manual coding methods with DeepLabCut, we explore the potential of AI tools in identifying key temporal-visual markers like mutual gaze and affective touch, to uncover patterns and trends that might not be evident through manual observation. Parent-Infant interaction videos were recorded at 1 and 5 months, each for 5 minutes without toys. The Datavyu coding scheme was designed to extract parameters including the incidence of affective and affectionate touch, mutual gaze, parent and infant cut gaze (looking away despite being looked at) and multimodal mutual gaze (mutual gaze with affective touch), which were computed in R. DeepLabCut was trained to track body parts in the videos, focusing on the nose, mouth, eyes, and wrists, as well as markers like mutual gaze and affective touch (Mathis et al., 2018). After training on over 200 labeled frames, new videos were analyzed. Preliminary results examine changes in parent-infant interaction behaviours for four participants at 1 and 5 months, alongside an initial analysis of the accuracy of DeepLabCut evaluations for one participant at these ages. Between 1 and 5 months, individual differences in touch patterns

emerged, with higher incidences of affective touch observed in the 1-month samples. DeepLabCut's accuracy, compared to manual coding, was 68% at 1 month and 77% at 5 months.

## PA-55 Explaining figurative language comprehension through concrete and abstract thinking in context

Tone Kristine Hermansen[1], Claire Prendergast[1], Selma Kollstrøm[1], Ellen Breitholtz[2], Christine Howes[2]
[1]University of Oslo, University of Oslo, Norway; [2]University of Gothenburg, Sweden

The social, cognitive, and linguistic abilities that underpin figurative language comprehension are typically established by around 4 to 6 years of age (Vosniadou & Ortony, 1983; Caillies and Le Sourn-Bissaoui, 2008). However, even into late childhood and sometimes adolescence, individuals continue to struggle with going beyond the literal meanings of figurative expressions such as metaphors and idioms. Decades of empirical research reveal a broad and varied age range for the acquisition of different forms of nonliteral language (for review see: Colston, 2020). To reconcile the apparent contradictions in findings about whether children can understand figurative meanings at specific ages, we propose that children's comprehension may be better understood ontologically by examining neuro-cognitive tendencies in concrete-to-abstract thinking in context. We employ the Behavior Identification paradigm, adapted from Gilead et al. (2014), to prime 5- and 7-year-old Norwegian-speaking children (N=100) with either 'how' (concrete thinking), 'why' (abstract thinking), or no questions (control) prior to an open metaphorical image-matching task. Our hypotheses are: H1—children primed with 'why' questions will be more likely to select metaphorical matches (e.g., beehive for orchestra) due to the activation of more abstract thinking; and H2—children primed with 'how' questions will be more likely to select part-of relations (e.g., conductor for orchestra), reflecting a concrete thinking approach. Preliminary data analysis shows marginally significant differences for H1 and significant differences for H2 in mean choice behavior across groups. We further explore additional behavioral factors, such as the level of abstractedness of answers given during the prime, and gaze behavior during the task. We also control for various demographic and experimental variables collected during the study, including relational memory and metaphor and idiom comprehension in narrative storytelling, and interpret these alongside self-report data collected from the parents and experimental data acquired from adults (N=30) tested on the same task.



## PA-57 The effect of maternal attention-following on the relationship between SES and infant exploration

Dilara Özalp, Berna A. Uzundağ
Kadir Has University, Turkey

Infant exploratory behavior is a key precursor to cognitive skills such as problem-solving(Bourgeois et al., 2005). While some studies have found a link between socioeconomic status (SES) and the

complexity of infant exploration (e.g., Clearfield et al., 2014), others have reported nonsignificant relations (e.g., Holland et al., 2023). These conflicting findings may be due to the lack of consideration of moderating variables. Infant exploration has been positively associated with maternal attention-following, which refers to a mother's focus on the object the infant is attending to (Pridham et al., 2020). This study investigates whether maternal attention-following moderates the relationship between SES and the complexity of infant exploration. Participants included 110 infants (age range=9.7-15.9 months; M(SD)=11.9(1.4); 46 girls) and their mothers. Maternal attention-following, defined as talking about, touching, or showing the object the infant was focused on, was coded from 10-minute mother-infant free play videos. Infant exploratory behavior (i.e., mouthing, rotating, transferring, fingering) was coded from 6-minute infant solo play videos by using the coding scheme developed by Clearfield et al. (2014). The proportion of complex exploratory behavior was computed by dividing complex behaviors (rotating and transferring) by the total number of exploratory behaviors. SES included maternal education, employment status, and household income. SES was positively correlated with maternal attention-following ($r = .32$, $p < .001$) and the complexity of infant exploration ($r = .20$, $p = .039$), whereas infant age was not related to either variable. Maternal attention-following significantly moderated the relationship between SES and the complexity of infant exploration ($B = -.09$, $SE = .04$, $p = .033$). The moderating effect was significant at low levels of maternal attention-following ($B = .02$, $SE = .009$, $p = .009$) but not at high levels ($B = -.004$, $SE = .009$, $p > .05$). These results suggest that infants from lower SES families may rely more on attention-following as compensation for fewer environmental resources. Maternal engagement appears especially important in promoting exploratory behavior in lower SES households.



## PA-58 What do children think about collective guilt?

Pinar Aldan, Yarrow Dunham
Yale University, USA

Do we bear responsibility for harms we did not directly inflict but that were inflicted by our group, and from which our group has benefited? Adults' opinions vary on this question (Bonnot et al., 2016; Klandermans et al., 2008). Here we explored children's views of these cases to determine whether they believe responsibility lies solely with the original perpetrators or if they think current group members also bear responsibility for past harms committed by the group—in other words, whether they recognize the possibility of collective guilt. Across three studies (US-based 6-12-yr-olds, total N = 342 and comparison adult samples, total N = 442) we presented participants with vignettes in which an advantaged group could compensate a disadvantaged group that they had previously harmed or that was disadvantaged for independent reasons. We also varied whether the disadvantaged group had or had not economically recovered. Younger children believe that a wealthy group should always compensate a poorer group, but older children think more compensation is needed when the advantaged group caused the harm, aligning with adults. Older children also believe that monetary compensation and an apology should be provided even if the disadvantaged group has economically

recovered from inflicted harm, and even when the current members of the advantageous group do not directly benefit from this harm, while adults are ambivalent in these cases. Though these results are limited by a US-based convenience sample, they suggest that, like adults, children attribute collective responsibility for wrongs committed by a group's forebears, especially when the disadvantaged group has not recovered from past harm. However, children may actually be more likely than adults to expect compensation to be provided when the disadvantaged group has fully recovered from past harm. In this sense children may actually have a broader notion of collective responsibility than adults.

## PA-59 Parental input involving perspective coordination in 12-month-old caregiver-infant dyads

Louise Lund Petersen, Nicolas Goupil, Dora Kampis
University of Copenhagen, Denmark

What enables children to begin to remember details from their lives, such as where they know something from, and form memories of unique episodes? Episodic memory has been proposed to serve a social function in adults. In development, many have emphasized the role of caretaker-child conversations that involve exchanging perspectives about events. Yet even earlier, infants participate in joint attention interactions, where with the caretaker they attend to the same event and understand that they have a different perspective on the object to which they attend. The current longitudinal project between 12 and 36 month of age explores the hypothesis that understanding people's perspective as unique to individuals may be a driving force behind remembering unique episodes in episodic memory – and that caregiver-child interactions involving reference to perspectives shape this process. At 12 months, our cohort of infants (n=125, data collection finishes November 2024) participate in a range of parent-child interactions. In a 10-minute free-play we assess the dynamics of child-vs. parent-initiated joint attention episodes. In a storybook-telling session we code parental mental state language. Finally, in a novel session with dual-aspect objects we code the references to different aspects of the objects, and how the dyads interact with objects that look differently from two sides, or can have different appearances (e.g., reversible toys). We will present the types and prevalence of verbal references and performed actions within dyad, that involve perspective coordination and perspective switches in our cohort of caregiver-child dyads at 12-months of age. Together, this battery allows to probe from various angles how parent-child dyads engage in interaction that may facilitate the understanding of perspectives being bound to people. Ultimately, the goal is to provide an assessment of what factors from interactions in caregiver-child dyads contribute to forming increasingly unique representations of perspectives, and ultimately, memories.

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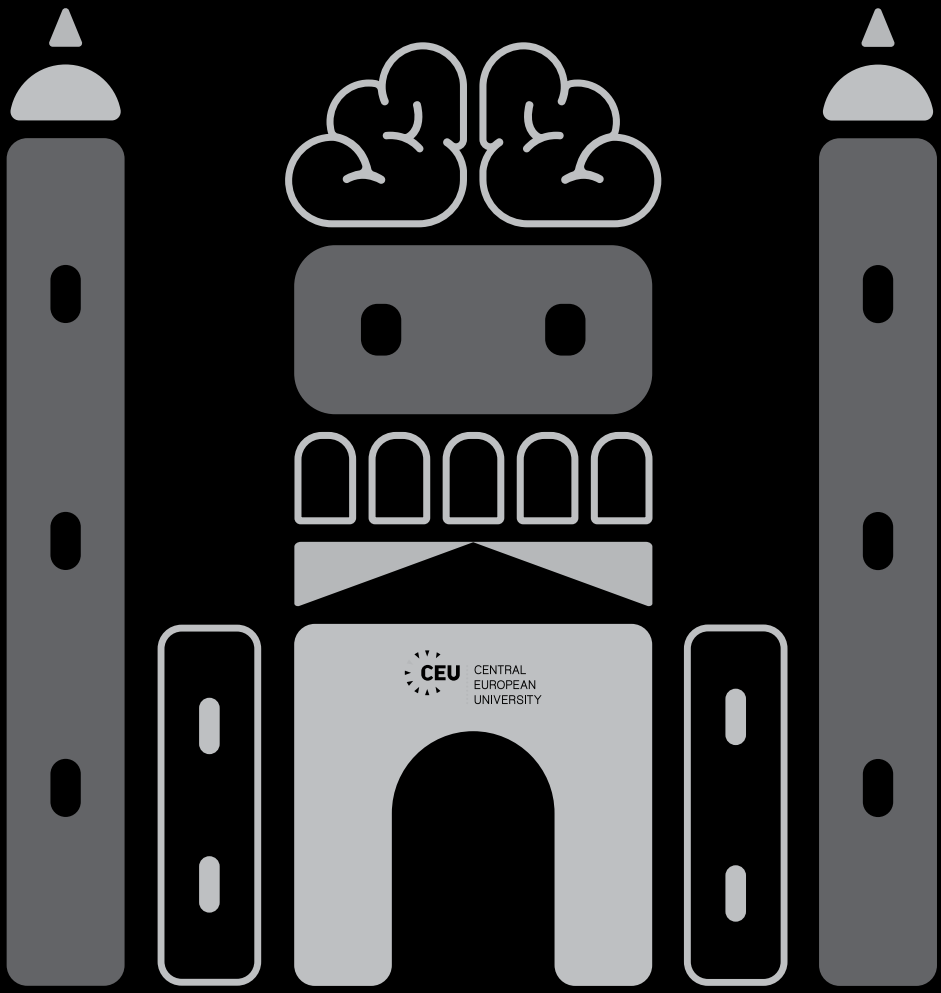

# POSTER SESSION B: FRIDAY

## PB-02 Does anticipated cooperation elicit group preference irrespective of group membership in children?

Jolanda Bababebole, Sarah E. Martiny, Mikołaj Hernik
UiT The Arctic University of Norway, Norway

Misch et al. (2021) tested whether in children minimal-group allocation acts as a signal for anticipating future cooperation within a group, which in turn triggers preferential bias towards the members of the group of future cooperation partners. The authors found a robust ingroup bias in children assigned to a minimal group and led to expect cooperating with its members. They also found a decrease in ingroup bias among children assigned to a group but later led to expect cooperating with an outgroup. However, since participants were told about the cooperative game before group assignment, the role of minimal-group assignment remains unclear. The present study has two goals: (i) we attempt to replicate Misch et al's findings, and (ii) we test whether anticipating future cooperation alone, i.e. irrespective of minimal-group assignment, is sufficient to elicit group preference. Specifically, in two new conditions we test whether children not assigned to any of the participating groups show a preference for the group they are led to anticipate cooperating with. Participants are told that they will play a computer game with members of a group. Next, as a result of manipulated internet connection, participants learn that they are to play either with the initially designated group or with another group. The study uses an experimental 2 (participant assigned to any group: yes vs. no) x 2 (internet connection to the designated group: yes vs. no) between-participants design. Preferences for the groups are measured before and after the manipulation, and additionally after the mock collaboration. We also check participants' memory for their group membership, or for lack thereof. We aim to recruit 140 participants (age: 6-11) from schools in Tromsø, Norway. The hypotheses and methods of the study are preregistered. Data collection and analyses will be finished before the conference.



## PB-03 Investigating prenatal speech processing in foetuses with and without increased likelihood of developing autism: Preliminary analysis

Saniye Betul Teksin, Kirsty Dunn, Calum Hartley
Lancaster University, UK

When talking to babies, adults often use infant-directed speech (IDS) characterized by altered linguistic patterns and prosody. Neonates can discriminate between IDS and adult-directed speech (ADS) and prefer listening to IDS, suggesting a genetic basis for IDS (Kaplan et al., 1996). Infants with increased likelihood of developing autism due to family history show reduced and delayed preferences for IDS, indicating genetic differences in their speech perception (Curtin et al., 2013). However, genetic explanations for IDS overlook prenatal environmental influences. Here, we investigate to what extent IDS sensitivity is predicted by maternal stress in foetuses with and without family history of autism. Foetuses at 32-34 weeks' gestation will be exposed to IDS, backwards IDS (B-IDS), and

ADS; currently, data from 45 participants have been collected. Discrimination of speech conditions will be indexed using foetal heart rate and behavioural measures using 4D ultrasound. Maternal emotional experiences will be measured using questionnaires. We predict that foetuses will show greater arousal in response to unfamiliar language (B-IDS) compared to IDS and ADS, demonstrating an ability to discriminate the linguistic components and prosody of speech in the womb. We also anticipate that foetuses with family history of autism and those experiencing greater maternal stress will show smaller differences in sensitivity to changes in speech conditions. Evidence that variation in IDS sensitivity between foetuses with and without family history of autism is predicted by maternal emotional states would potentially offer a non-genetic explanation for population differences in speech perception. However, if family history of autism predicts variability over-and-above maternal stress, this would indicate that IDS sensitivity is influenced by both genetic and environmental factors. Understanding the early mechanisms of autism and prenatal environmental influences on speech perception is important to support maternal mental wellbeing.

## PB-04 Assessing preschoolers' structural action processing in a stacking game using fNIRS

Lea Haerms[1,2,3], Laura Maffongelli[4], Charlotte Grosse Wiesmann[3], Markus Paulus[2], Angela Friederici[3], Nicole Altvater-Mackensen[1,5]

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The ability to plan and understand complex actions considerably develops around the preschool years. Previous research suggests that structural action processing recruits the inferior frontal cortex (IFC), which is critically involved in hierarchical processing in language (Fadiga, et al., 2009). Recent meta-analyses on action and language processing in adults suggest that different subregions of the left IFC underlie structural processing of language and action (Zaccarella, et al., 2021). However, to this date, the underlying neural mechanisms of children's action processing are largely unknown. Here, we compare structural action processing and its neural correlates in children and adults using a stacking game while measuring fNIRS. We instructed N=78 children and N=47 adults to place six blocks varying in shape and size on to a small board to build a pathway for two toy figures. Task levels included two condition structures: Sequential action sequences, in which the placing order of the blocks was flexible, and dependent action sequences, in which the blocks needed to be placed in a specific order. Participants were presented with twelve levels of increasing difficulty, six in each condition. We measured neural response using fNIRS in a 30 second planning phase, where the setup was revealed but out of reach, followed by a 60 second building phase, in which the task was solved. We hypothesized that structural complexity of action sequences modulates the activation of regions in IFC, with stronger activation for dependent than sequential sequences. If such activation indexes structural processing, we further expected correlations between task performance and

neural response. The data is currently being analyzed. Contrasting with previous findings on language processing, our preliminary results show right lateralized modulation in IFC activation depending on complexity of action structure and behavioral performance in children.

## PB-05 Children's preference for democracy erodes in light of personal reward

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Do children prefer democratic leaders? In this project we test the strength of children's (aged 6-14) preference for a democratic leader (who enacts the preference of the majority) and the circumstances under which that preference can be eroded in favor of an autocrat (who enacts their personal preference). Children play multiple rounds of a game against fictional players in which they collect one of two possible types of objects (e.g., apples or bananas). Children select which objects they want to collect before the game begins. In the first two rounds, either the democratic leader or the autocratic leader (order counterbalanced) makes the choice about which of two possible paths to take (e.g., the path that has more apples or the path that has more bananas). The child is thus exposed to the leadership style of each leader: the democrat, who chooses the path that has more of the type of object being collected by a majority of players, and the autocrat, who chooses the path that has more of the type of object that they themselves are collecting. In the third round, the leader is decided by an election in which the children get to cast their vote for one of the two leaders. Before voting, children learn the expected behavior of each leader: i.e., whether or not their preference is aligned with the majority (i.e., the path the democrat will choose) and whether or not their preference is aligned with the autocrat (2x2 between-subjects design). Data collection is ongoing (n=84) and preliminary findings suggest that when self-interest is not at stake, children prefer democratic to autocratic leaders. However, once self-interest is at stake, children's behavior is strongly influenced by the promise of personal rewards, leading them to shift their preference to the autocratic leader.



## PB-06 Has it happened yet? Young children do not distinguish between physical and epistemic uncertainty when reasoning about incompatible possibilities

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When anticipating possible outcomes of a situation, we can experience different kinds of uncertainty. Physical uncertainty arises when there are several possibilities of how an event might unfold but it has not yet happened, whereas epistemic uncertainty arises when one of several possible events has already happened but one does not (yet) know which one. Previous findings suggest that young children find it more difficult to prepare for incompatible possibilities under epistemic uncertainty

than under physical uncertainty (Robinson et al., 2006). However, the epistemic condition may have posed additional cognitive demands. In the current project, our aim was thus to compare children's ability to prepare for incompatible possibilities under the two kinds of uncertainty with a minimal contrast between conditions. In our task, children were shown a set-up with two slides, balls and wagons. Children prepared to catch one ball whose trajectory was either known (control trials), unknowable (physical condition) or unknown (epistemic condition) by pushing one or two wagons under the slides. Across two studies, we could not replicate the findings by Robinson et al. (2006): In Study 1 (N = 129, ages 3 to 6), which was conducted online, we found no differences between the uncertainty conditions. Preliminary results of Study 2 (n = 59, ages 3 to 5), currently in data collection in the lab, appear to replicate Study 1. Our findings stand in empirical tension with previous results, and in conceptual tension with recent theoretical work on the development of modal cognition: It has been suggested that reasoning about possibilities under epistemic uncertainty should be more complex and thus later-developing since it requires one to anchor one's simulation of possible outcomes meta-cognitively within one's own epistemic state of uncertainty as opposed to the current state of the world (Phillips & Kratzer, 2024).

## PB-07 Loyalty under pressure: Children managing conflicting motivations in epistemic decisions

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How do social context and the characteristics of the information source influence information-gathering behavior? In this project, we pit leadership traits (i.e., task-specific competence and prosociality) against social goals (i.e., the motivation to be on a winning team rather than a losing one). In the protocol, children aged 9-14 years (n=188) first choose which of two leader's teams to join. After playing a few rounds of a game, their team is either winning or losing. During this time, children are simultaneously exposed to the fact that one of the two team leaders is either competent while the other is incompetent, or supportive while the other is arrogant. When it is time for the two teams to collaborate on a decision, participants are given the opportunity to gather information from both their own team leader and the opposing team's leader. We measure which leader they gather information from first, whether they gather information from both leaders or just one, and which information they ultimately use to make their decision. We find that while most participants gather information from both their team leader and the opposing leader, which leader they gather from first is significantly impacted by both their team's status (i.e., winning or losing) and the traits each leader displays (i.e., either competent versus incompetent or supportive versus arrogant). When the participant's team is winning, there is no difference between which trait is being displayed by either leader. Instead, participants prefer the leader that is displaying the positive version of the trait. However, when the participant's team is losing their preference for traits is conditional upon which

leader is displaying them. When losing, a competent team leader is more valued than a supportive one, while a supportive opposing leader is more valued than a competent one.

## PB-08 Challenging misinformation: The role of linguistic encoding

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Children do not accept all information they are told as true; they evaluate the reliability of their sources and selectively trust reliable informants over unreliable ones (Harris, 2012). However, it is unclear whether children's vigilance towards misinformation varies depending on whether the information is presented as a presupposition or an assertion. Theoretical and experimental work with adults suggests that presuppositions are less likely to be challenged than assertions (Von Fintel, 2008; Lorson et al., 2019). This study investigates whether children are less likely to challenge false presuppositions than false assertions and whether doing so is more cognitively demanding. We tested 35 children (7/8-year-old) and 41 adults using a role-play scenario where participants, acting as detectives, interrogated puppet suspects in a robbery case. Each suspect provided inaccurate information either as part of the asserted content or the presupposed content. Participants were tasked with challenging the misinformation and justifying their challenges. Both children and adults were generally accurate in their challenges, with adults performing at ceiling levels. Children provided more incorrect or vague justifications for presuppositions than for assertions. Importantly, while both groups challenged presuppositions as often as assertions, they were significantly faster in contesting false assertions, with greater variability in response times for presuppositions. These findings suggest that challenging presuppositions is more cognitively demanding than challenging assertions, with individual differences potentially influencing these cognitive costs.



## PB-09 Impact of electronic device exposure on sleep and language development in infants

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Irregular living environments, such as poor sleep hygiene, noise, and exposure to electronic devices, may affect sleep patterns (Ogundele & Yemula, 2022). Developing a regular sleep-wake cycle represents a challenge for young children (Mainieri et al., 2021) but also a possible concern for families. Experiencing disrupted sleep may severely affect the family's well-being and the infant's cognitive development (Spruyt, 2019). However, so far, a few studies analyzed the intricate relationship between environment, sleep problems, and language abilities. We aim to understand how electronic devices exposure affects children's sleep and how sleep problems affect vocabulary size and sleep features. Fifty-one infants (17-months) wore a recorder, the Language Environment Analysis (LENA),

to assess the percentage of TV and electronic device exposure (EXP) during the day and before the time they go to bed. Their parents completed a sleep diary and the Sleep Disturbance Scale for Children (SDSC). Sleep routines were analyzed using the diary, and sleep problems were identified through the SDSC. MB-CDI was used to determine vocabulary size. Results indicate that EXP during the day determines higher sleepiness in the morning (r=.278, p=.05) and EXP the hour before going to sleep correlates with difficulties falling back asleep after waking up at night (r=.303, p=.032), or nightmares (r= .311, p=.028). Also, infants, whose parents perceived more sleep difficulties, show smaller vocabulary (M=19.71words) and more frequent night-awakenings (M=2.56) if compared to infants without difficulties (M=36.45words; night-awakenings: M=1.50; all ps<.05) Our findings confirm previous research showing that exposure to electronic devices may contribute to sleep difficulties in infancy. This, in turn, could affect infants' vocabulary development, possibly due to a failure in the consolidation mechanisms regularly triggered during sleep. Understanding the direction of this relationship is crucial for preventing potential long-term sleep and language difficulties, making it an important area for future research.

## PB-10 What to practice: Young children's adaptive training decisions in motor sequence learning

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Skill learning requires practice tailored to task difficulty, learning goals, and the progress of the learner. When does the ability to make adaptive self-directed practice decisions emerge and how does it develop across childhood? Toddlers have some awareness of their own uncertainty (Goupil et al., 2016), and preschoolers modulate their efforts in a task based on their performance improvement (Leonard et al., 2023). However, children tend to overestimate their abilities (Plumert, 1995) and go through substantial development in understanding deliberate practice after age 4 (Brinums et al., 2018). Nevertheless, with low memory demands, even 4-5-year-olds can make adaptive training decisions in simple motor learning contexts, in preparation for uncertain test events (Serko et al., under review). This project investigates whether children practice tasks adaptively when learning motor sequences. In a within-subjects design, N=133 4–8-year-olds (Mdn_age=79 months, 66 females) played a tablet-based tapping game adapted from the Serial Reaction Time task (Nissen & Bullemer, 1987). In each of three conditions, participants were first familiarized with an easy and a difficult sequence, then informed that they would later be tested either on the same Easy, Difficult, or a Randomly drawn (the easy or the difficult) sequence. Before the test, they could choose to practice one of the two previous sequences. We analyzed practice decisions across conditions and age. The majority of participants practiced the easy sequence in the Easy (67%), the difficult sequence in the Difficult conditions (63%). Overall, more older (60%) than younger children (49%) practiced the difficult sequence in the Random condition, although the proportions of adaptive decisions were significantly

above chance level only in the last round. Our results suggest a behavioral pattern similar to previous findings, with a possible later emergence of adaptive decision-making in sequence-learning than in other contexts. We discuss potential reasons for this difference.

## PB-11 In the blink of an eye: Neural face selectivity emerges at a single glance with adapted natural stimuli as early as 2 months of age

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In previous studies, face selectivity was assessed in fMRI from 2 months of age using second-long videos but in scalp EEG it was found only weak at 4 months using complex and briefly presented stimuli. Whether early face selectivity can be demonstrated with short presentation times if stimuli better suit the typical low visual capability in early infancy is still an open question. Using frequency-tagging EEG, we presented face and nonface stimuli at a rapid rate of 6 images/s during 36-s-long sequences, with faces appearing once per second, i.e., as every 6th stimulus, therefore isolating face selectivity at 1 Hz in the EEG spectrum. Two sets of images were used in separate trials: a "classic" set from previous studies and a "new" set allowing higher clarity of the depicted items. In Experiment 1, we validated the use of the new set to elicit high-level face selectivity in adults (N = 19). Crucially, Experiment 2 demonstrated benefits from the new set for 2-to-6-month old infants (N = 46). In fact, the 2-to-3-month-olds featured a face-selective response only in the new set, despite very tight presentation constraints (i.e., 167-ms presentation duration immediately backward masked). Thus, adapting stimuli to the visual capabilities of infants allowed detecting likely underestimated face selectivity of neural circuits which present an impressive reactivity to rapid visual stimulation.



## PB-12 Understanding deception: Epistemic vigilance in individuals with Williams syndrome

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Epistemic vigilance allows individuals to minimize the risk of deception by assessing the reliability of information sources and calibrating trust accordingly (Sperber et al., 2010). Little is known, though, of whether vigilance against deception is present in neurodevelopmental conditions like Williams syndrome (WS). WS is a rare genetic disorder marked by intellectual disabilities, pragmatic challenges, and difficulties with Theory of Mind (Korenberg et al., 2000). Notably, individuals with WS are often highly social, exhibiting a strong desire for interaction and minimal social fears (Järvinen et al., 2013) and their trustful attitude, even towards strangers, increases their risk of social vulnerability (Lough et al., 2016). This pre-registered study examines epistemic vigilance towards deception in individuals with WS using three main tasks adapted from Mascaro & Sperber (2009): 1) a False Communication

Task, where participants are asked to repeatedly guess the location of a hidden marble based on the testimony of a single informant that turns out to be consistently inaccurate; 2) a Selective Trust Task in which participants choose between the conflicting testimonies of two informants explicitly described as reliable and unreliable ("X wants you to find the marble" vs. "Y does not want you to find the marble"); and 3) a False Communication Task, with a single informant that is both described as unreliable and exhibits repeated inaccuracy. This exploratory study includes participants with WS aged 6 and older, alongside a control group of typically developing children matched by gender and cognitive abilities. Individuals with WS are expected to require more evidence to distrust an inaccurate speaker compared to the control group. Furthermore, it is hypothesized that both WS and typically developing children will perform better in the selective trust task than in the false communication tasks. The poster will present the study's rationale, design, and preliminary findings.

## PB-13 Second language proficiency impacts switching and visual working memory in neurotypical and autistic children

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Executive functioning (EF) refers to cognitive processes like visual working memory (vWM) and switching (Diamond, 2013). Individuals with Autism Spectrum Disorder often struggle with EF (Margari et al., 2016). Bilingualism, the ability to understand or speak more than one language (Grosjean, 1982), has been reported to enhance EF (Bialystok, 2017). Specifically, highly proficient bilinguals are hypothesized to strengthen their cognitive control more than monolinguals or less proficient bilinguals, due to increased managing of interference between languages (Blom et al., 2014). However, while some studies report better EF performance in bilingual children compared to monolingual peers, others find no effects (Bialystok, 2024). One contributor to null effects may reflect oversimplified measurements of bilingualism, which notably varies in age of first exposure to a second language (AoFE-L2), language use and second language proficiency (L2-proficiency) (Grundy, 2020). This study examined effects of these processes, including L2-proficiency, AoFE-L2, and balance of use, on vWM (Morales et al., 2013; Figure 1) and switching (Zelazo, 2009; Figure 2). We hypothesized that higher L2-proficiency, earlier AoFE-L2, and more balanced use of up to three languages would predict greater EF accuracy in 220 NT (M = 7;9, SD = 2;5) and 109 autistic children (M = 8;9, SD = 2;1) for vWM, and 179 NT (M = 8;1; SD = 2;3) and 78 autistic children (M = 9;3, SD = 1;12) for switching. Analyses examined main effects and interactions among variables using GLMM, controlling for age and socioeconomic status. Results showed a significant group difference and effect of age. There was no effect of balance of use or AoFE-L2; in contrast, greater L2-proficiency was a significant predictor of better switching and vWM (Table 1, Figure 3); there were no significant interactions. Results indicate that L2-proficiency played a key role in enhancing the cognitive control abilities investigated.

## PB-14 Can object exploration or explanation-generation facilitate innovative problem-solving in 5–7-year-olds?

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Many everyday tasks demand physical problem-solving skills, such as object manipulations or tool-generation, to solve. However, children display great difficulty in innovating solutions to physical problems independently until around 8-years-old. This pre-registered study investigates whether encouraging children to (1) explore materials freely or (2) generate explanations could support problem-solving performance. Children aged 5-7-years completed two tasks (the hook-tool and water-displacement task), each potentially drawing upon an understanding of object functionality to solve. Functional items were presented alongside visually matched non-functional items for each task. Children were assigned to one of three conditions which involved: (1) exploring task materials, (2) explaining their use, or (3) a control group. Overall, 48.2% of children (N=83) solved the hook-tool task, while 59% succeeded in the water-displacement task. Condition did not significantly predict success, indicating neither exploration nor explanation directly aided performance. However, children in the Explore condition were significantly more likely to use the functional item on their first attempt to solve the puzzle ($\chi^2$ (3) = 10.625, p =.014), indicating that tangible interactions supported their understanding of how to use the materials most effectively. The pass/fail conceptualisation of innovative success dominating existent literature may be constraining our understanding of children's innovative competence and subsiding differences between conditions in this study. To surpass this limitation, a detailed exploratory analysis of which behaviours supported successful performance was undertaken. Results from both tasks indicate that autonomous exploration, independent discoveries, and the iterative refinement of tools were linked to better outcomes, consistent with prior research (e.g., Bonawits et al., 2011; Burdett & Ronfard, 2023). Analyses of verbal utterances generated by children in each task revealed an association between cognitive speech and success, aligning with Breyel and Pauen's (2022) observations. The benefits and limitations of using an open-ended, discovery learning approach in facilitating innovation are considered.



## PB-16 Individual differences in 12-month-olds' pupillary responses to size and luminance of stimuli

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Measurement of pupil dilation is increasingly applied to investigate cognitive processes in infants. However, parameters such as differences in the stimulus' luminance or participants' gaze direction can affect pupil measures as well. Infants are likely to move their eyes freely across a visual scene.

Even if experimental conditions are generally controlled in luminance, unpredictable fixation locations on stimuli that vary in luminosity will lead to confounds or noise in pupil measurement. In adults, local pupil contrast was assessed within a 10° area around fixations and successfully used to adjust pupil data. Here, we investigate the possibility to predict pupil light reflexes in infants. 12-month-olds (N = 93) saw disks of different sizes (i.e., 9.5°, 13°) and in two luminance levels (light and dark grey) at several locations on a medium grey background, matching areas of interest (AOIs) in a larger pupillometry study. Additionally, light and dark grey backgrounds were alternating without disks. Animated attention grabbers with the same luminance levels were centrally placed on the AOIs. Because same-aged infants can vary strongly in their visual development, we assessed interindividual variability in the onset and duration of infants' pupil adaptation to the changing luminance levels. Moreover, mean luminance within a 10° diameter around the infants' gaze point was assessed, and explained more variance of the changes in pupil size ($R^2$ = .225) than the factor target luminance ($R^2$ = .101). Because the radius that approximates pupil contrast in infants is not yet known, we will additionally compute mean pixel luminance in different radii around each fixation. Insights received from these analyses are intended to be included into models on psychological pupil dilation to reduce confounding effects due to luminance differences.

## PB-17 Information gain modulates information search behaviors across development

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he "information-gap" theory (Loewenstein, 1994) argues that human curiosity emerges when an individual identifies a knowledge gap, which motivates them to seek out information. This account has also been influential in artificial intelligence, with many curiosity-based systems using increases in information gain (IG) as a reward signal. Across four studies, we investigated whether the anticipation of information gain could act as an intrinsic reward, motivating information-seeking behaviors from the earliest stages of life (Study 1) and charted the developmental trajectory of this effect (Studies 2-4). In Study 1, we tested 46 toddlers between 13 and 21 months of age on a gaze-contingent version of a search persistence task (Ruggeri et al., 2024) and measured changes in pupil size and looking time during search. Studies 2 (3-to-5-year-olds, N=80) and 3 (5-to-11-year-olds, N=133) tested children with two age-appropriate tablet-based versions of the task and measured how long participants persisted in searching. Lastly, in Study 4 (N=120), adults were tested on an equivalent version of the tablet-based task. In all studies, participants played a simple information search game in which they searched for an object hiding behind a potentially infinite series of doors. The object was only revealed at the very end of the experiment. Across two conditions, we manipulated the degree of uncertainty (low vs. high) as to which specific object participants were searching for. We found that children were more persistent in conditions where there was higher uncertainty as to which object they would find, and therefore more information to be gained. However, the effect disappeared in

adults. These results indicate that, in the absence of any rewards, children's search is motivated by the expected informativeness of the actions that can be performed, highlighting the importance for research on artificial intelligence to invest in curiosity-driven algorithms.

## PB-18 Children's age-related inferences based on prosodic cues in child-directed speech

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From a young age, people flexibly modify their speech depending on the attributes of their communicative partner. Child-directed speech (CDS) is a widely-studied example. Several studies, contrasting child- and adult-directed speech, demonstrated that starting in infancy, listeners can readily distinguish these two registers (e.g., Bryant & Barrett, 2007; Fernald, 1989). Nevertheless, CDS also varies considerably depending on the recipient child's age (e.g., Kitamura & Burnham, 2003; Stern et al., 1983) and adult listeners are sensitive to these age-related variations (Bozkurt & Soley, 2022). Here, we examine whether such sensitivity extends to young children. We recorded Turkish-speaking mothers' speech while describing the same objects to their two children, whose ages varied between 6 and 68 months. Following this, we created 6 pairs of speech segments (8.1 seconds long), where the age difference between the recipients in each pair was either 2, 3, or 4 years. On each of 6 trials, 3- to 6-year-old children (N = 76, 34 female) were shown a mother figure on the screen and listened to two speech segments produced by the same mother. Then, they were shown a baby and a child figure on the screen, listened to one of the two segments once more, and asked whom the mother was addressing. The GLMM analysis showed that the age of the participating children was a significant predictor of their ability to infer the recipient's age based on the CDS. Specifically, the ability to accurately identify the target's age improved as the participant children's age increased (Estimate = 0.03, p = .003). No effect of the age difference between speech pairs was found on the children's accuracy. The current findings provide insight into children's early developing ability to perceive social cues from speech, which might be later utilized for effective communication and social interaction skills.



## PB-19 Antitonicity (order-flip) as a foundational logical concept in infancy

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Concept learning, the capacity to infer a novel rule based on a finite number of examples, is a powerful learning mechanism. Adults' concept learning is affected by logical complexity, where novel

categories with higher logical complexity are harder to learn (Feldman, 2000). However, the role of logical representations in infants' learning is unknown: do babies use logic to learn new concepts, and if so, what logic do they use? Here, we focus on preverbal infants' capacity to learn new rules about order transformations and ask whether they spontaneously use the logical concept of Order-Flip (an antitonic function that flips the ranks of an ordered domain). This basic concept might support learning in many content domains, including perceptual magnitudes, mathematics, natural language semantics, and language processing (Icard & Moss, 2014). Across four experiments, 14-month-olds (N=59) were habituated to exemplars of arbitrary order rules (e.g., fish swim in a specific order and then start to fly in the opposite order) and then tested (within-subject) with new exemplars that either corresponded to the rule or violated it (Fig.1). Infants habituated to an Order-Flip dishabituated to an Order-Match (experiment 1), showing they can distinguish the two; but when habituated to an Order-Match, didn't dishabituate to an Order-Flip (experiment 2), showing that an order manipulation helped to form rule representation in experiment1. Infants habituated to an Order-Flip dishabituated to an Order-Shuffle (experiment 3), revealing a finer-grained representation than "Order-Change". Finally, infants habituated to an Order-Shuffle didn't dishabituate to a novel type of Order-Shuffle (experiment 4), indicating that, for the infant mind, Order-Flip might be a simpler representation than Order-Suffle (Fig.2). These findings support an exciting proposal: Order-Flip might be a core representation of a natural logic available from infancy to learn new concepts.

## PB-20 Women's approach behaviors toward children: Roles of facial cuteness

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Children's cuteness instinctively triggers women's approach behaviors. Previous studies have shown that women are more likely to approach children's faces than adult faces (Kuraguchi et al., 2024); however, they do not clarify how varying levels of cuteness in children's faces influence these behaviors. This study aimed to address this gap by investigating how different levels of facial cuteness affect women's approach behaviors using images controlled for baby schema. Given that questionnaire-based studies show cuter children receive higher approachability ratings, we hypothesized that women would shift their center of pressure (COP), an index of approach/avoidance behaviors, toward faces with higher baby schema. The study involved 27 nulliparous women who viewed images of 10 infants' faces, each manipulated to represent three levels of baby schema using morphing techniques (Nittono et al., 2022), along with 10 adult female faces. COP changes were measured using a Wii Balance Board, and participants rated the cuteness of the faces on a 7-point Likert scale after viewing each image. Results showed significant effects of baby schema on cuteness ratings. However, COP changes were not significant at the 6-second (total stimulus duration) or 500-millisecond (previously linked to approach behaviors) intervals, suggesting that perceived cuteness influences ratings but not measurable approach behaviors within these timeframes. Nonetheless, the results seem to suggest distinct patterns in averaged COP changes

between these intervals: higher baby schema led to approach behaviors at 500 milliseconds, but to avoidance behaviors at 6 seconds, contrary to our hypothesis. The latter result may be due to cuteness narrowing attention, which requires greater distance to capture the overall picture, leading to a posterior shift in COP. Thus, the minimal impact of facial structure on averaged COP changes suggests that response timing could be a crucial factor. To explore these temporal dynamics further, we plan a time-series analysis.

## PB-21 Early expressive and receptive language development in preterm versus full-term infants: A meta-analysis

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Preterm birth (< 37 weeks gestational age) is a global public health concern, affecting more than 13 million (10 %) infants worldwide annually. Although studies suggest that preterm infants are more likely to develop speech or language disorders compared to infants born full-term, research on language development of preterm infants in early childhood has yielded inconsistent results. This meta-analysis synthesizes existing literature on the early development of receptive and expressive language in preterm compared to full-term infants in the first 18.9 months. Studies must have used either the Bayley Scales of Infant and Toddler Development (BSID), version 3 or 4, or the MacArthur-Bates Communicative Development Inventory (CDI), all versions. We searched electronic bibliographic databases, including Scopus, Web of Science, and EBSCO, for studies published until December 2023. Our search yielded 9464 records. Studies were screened using AsReview and checked for inclusion and exclusion criteria. To ensure comprehensive coverage, we used cross-referencing techniques to screen for any studies that might have been missed. A total of 34 studies were eligible, and study outcomes were transformed into Hedge's g. Robust variance estimation was conducted for each outcome. Results indicate that children born preterm score lower in receptive (g = -0.40, CI 95 = [-0.60, -0.19], p < 001, I2 = 71.80) and expressive (g = -0.44, CI 95 = [-0.63, -0.25], p < 001, I2 = 65.76) language. For receptive language differences, birth weight, gestational age, and corrected age were significant moderators, suggesting that differences are greater for preterm children with lower birth weight, higher corrected age, and lower gestational age. We will discuss our results in light of previous research and uncover gaps for future research.

## PB-22 The developmental trajectory of the infant altercentric biass

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Absent a self-representation before an age of 18 months, infants are proposed to, instead, have the other as the origin — or center — of their model of the environment: before the discovery of the self, infants are altercentric (Southgate, 2020). In a false-belief-like scenario we found direct evidence for an altercentric bias with 8-month-olds remembering an object's location where another agent saw it, instead of where they alone saw it transferred later (Manea et al., 2023). In the same series, another 12-month old group showed a reduced bias. Fourteen-month-olds display the bias for semantic information (Kampis et al., under review) or altercentric interference for object identity (Kampis and Kovacs, 2021). Grosse Wiesmann et al. (under review) found that at 18 months, only infants who passed mirror self-recognition (MSR) exhibited a self-reference effect (remembering objects assigned to self), while those who did not pass MSR remembered objects assigned to others better. All evidence so far is cross-sectional for what is a developmental hypothesis. We report data from a longitudinal study following 120 infants at 8, 12, and 18 months, tracking the altercentric bias at 8 and 12 months in the same individuals and relating it to their MSR at 18 months. Additionally, we tested the mechanism suggested by Southgate (2020), proposing that higher oxytocin levels delay the development of self, leading to stronger altercentric bias early (at 8 and 12 months) and delayed MSR at 18 months. We also considered the age of onset of walking as a covariate, given its potential role in explaining the reduced bias at 12 months, given that egocentric spatial origin is needed for traversing space (see, e.g., Filimon, 2015). Data collection for the 18-month cohort concludes in late September. At the time of writing, we confirm replicating Manea et al.; full results at BCCCD.

## PB-23 Cues that trigger the attribution of communicative agency

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Infants rely on various perceptual or behavioral cues when attributing agency to unfamiliar entities. For instance, they can use the contingent reactivity of the unfamiliar entities they are interacting with to categorize them as communicative agents in both first-person and third-person perspectives and follow their orientation change when they turn towards potential targets. While past experimental manipulations of contingent reactivity successfully mimicked the temporal aspects of well-formed communicative interactions, most studies used a limited set of behavioral cues to match infants' expectations about communication (e.g., contingently reacting entities turn their front towards the addressee), other potential cues remained unexplored. To investigate which contingent behaviors following human speech trigger agency attribution we familiarized two groups of twelve-month-old

infants with video animations presenting a group of novel entities that are addressed by a human adult. For one group (N=24), after being addressed, the entities expressed multiple behavioral cues, including orienting towards the speaker, moving into proximity, and getting spatially organized, while for the second group they remained passive. In the test phase, the entities turn toward targets positioned at the left or right side of the screen. Participants' eye movements were recorded using eye-tracking to assess their orientation-following behavior. If contingent reactivity to human communication is a precondition for infants to attribute communicative agency, orientation following should emerge when behavioral cues are present, but not when they are absent. Our results provide supporting evidence for this hypothesis, infants in the first group followed the orientation of the novel entities above chance ($t(23) = 4.26$, $P < 0.01$). In our subsequent experiments we aim to identify the behavioral cues that are sufficient to trigger the attribution of communicative agency.

## PB-24 Emergence of cognition through social development: From implicit to explicit theory of mind

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FB understanding was previously thought to emerge around age 4 (Wellman et al., 2001). However, more recent research suggests that it might be present as early as 15 months (Onishi & Baillergeon, 2005). Such empirical discrepancy between findings initiated a debate on the nature and development of implicit and explicit ToM. Consequently, various accounts that differ in terms of development have argued for different interpretations of these findings. Lean interpretation accounts argue that implicit ToM can be explained by behavior-reading in which understanding others depends on recognizing behavioral regularities (Perner & Ruffman, 2005). However, they struggle to account for the complexity of social interactions and have a developmental gap between behavior-reading and the more sophisticated mind-reading abilities that emerge later. In contrast, rich interpretation accounts acknowledge the importance of mental states in understanding others' behavior but vary in the extent to which their explanations are developmental. They range from innateness (e.g., Apperly & Butterfill, 2009) to development through socio-cultural interactions (e.g., Tomasello, 2018). However, all these accounts face challenges in explaining how mind-reading emerges due to the underlying assumption of a split between action and cognition and the subsequent need for a homunculus starting point - foundationalism (Allen & Bickhard, 2013). To address these challenges, action-based emergent constructivist accounts propose rejecting such a split (Carpendale, 2013). Interactivism is a specific action-based approach that emphasizes the emergence of understanding others through interactions within a sociocultural context (Mirski & Bickhard, 2021). The current study uses interactivism to provide a novel developmental account of the nature and transition between implicit and explicit ToM. This account proceeds by showing how an understanding of mental states through reflection (i.e., explicit knowing) emerges within an interactive understanding of the shared practices of social situations (i.e., implicit knowing).

## PB-25 The meaning of referential pointing for 14-month-old infants

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Infants have a remarkable capacity to understand pointing, which allows them to identify the referents of deictic gestures. The standard view holds that – in contrast to dogs (Tauzin, Csík, Kiss, Topál, 2015) – human infants interpret pointing as a referential gesture that indicates a target object. However, deictic gestures can also indicate a relevant location for an addressee. We investigated which one of these interpretations can explain infants' responses in a two-alternative choice task. We tested 14-month-olds who were assigned either to an Ostensive Pointing (N=24) or a Nonostensive Pointing (N=24) condition. In the Ostensive Pointing condition, the experimenter used infant-directed speech, mutual eye-gaze, and addressed the infant by name, while these cues were absent in the Nonostensive Pointing condition. In both conditions, the participant sat in front of a table facing an experimenter who placed an object on the left and another object on the right side of the table. The experimenter pointed at one of the two objects, swapped their positions in full view of the infant, and then allowed the infant to choose. In the Ostensive Pointing condition infants chose the previously non-indicated object at the indicated location significantly above chance (p=0.01). In the Nonostensive Pointing condition infants performed at chance-level (p=0.78). The two groups differed significantly in their average performance (p=0.027) and in the number of infants who preferred to choose the indicated location (p=0.038). These findings show that infants – in contrast to the standard view – interpret imperative pointing as indicating a location rather than an object, similar to dogs (Tauzin et al., 2015). This suggests that responses to deictic gestures may rely on evolutionarily ancient mechanisms in humans. In an ongoing experiment, we investigate whether ostensive labeling can override this location-based interpretation in infants.

## PB-26 Motivated ostracism: Preschoolers' choices of whom not to play with in group contexts with different goals

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Ostracism choices have been widely examined concerning social characteristics such as gender, race, group membership, and socioeconomic status (Burkholder et al., 2020; Tenenbaum et al., 2018; Gönül et al., 2023). However, only limited studies concentrate on contexts (e.g., Rubert & Greifeneder, 2016), and few of them focus on preschool children. Preschoolers are found to demonstrate exclusionary behaviors (Crick et al., 1997, 2006), and studies on group norms have also confirmed preschoolers' ability to understand group goals and group norms (Roberts et al., 2017; Sheikh & Hirschfeld, 2019; Wyne et al., 2020). This ongoing study investigates preschoolers' exclusionary choices when they face group contexts with different goals, and we aim to compare their choices with those of adults (Rudert et al., 2023). We adopt the paradigm in Rudert et al. (2023)

for children's easier understanding. Preschoolers are shown four animated cartoons with group activities aimed for fun and high performance. Each scenario includes two control agents and an experimental agent with undesirable characteristics, i.e., low warmth or low competence. We predict higher exclusionary preferences for these experimental agents when their characteristics contradict current group goals, such as displaying low competence in scenarios aimed for high performance and low warmth in scenarios for fun. We have preliminarily recruited 59 5-year-old children and analyzed their exclusionary choices with one-tailed binomial tests. Preschoolers tend to ostracize low-competence agents more than chance level in both scenarios ($p < .02$), as well as low-warmth agent in scenario aimed for fun ($p < .05$). Results also show they exclude agents with characteristics contradicting group goals more ($p < .01$), yet we find no difference across groups ($p > 0.2$). Overall, preschoolers tend to ostracize low-competence agents across contexts and show different patterns from adults. We will discuss the results after more analyses.

## PB-27 Changing currencies: Children's early-emerging intuitions about collective intention and functionality in institutional objects

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A unique aspect of society is the use of institutional objects, such as currency, which derive their function through collective intention as opposed to their intrinsic physical properties. Adults robustly represent that the function of institutional objects can change with changes in intention (understanding for example that if institutions change their currency object, you can no longer use that object to purchase things). Recent work has suggested this concept is relatively late-emerging in children, and even 7 year olds perform below chance when asked whether institutional functions can ge removed following changes in collective intention (Noyes et al., 2017). The reasons for this late emergence however remain unclear. We explored this question using a novel method focusing on currency, testing 187 children (ages 5-10) across two studies. We found that even children as young as 5 years old (compared to 8 year olds in prior work) succeeded at grasping the changes in the function of institutional objects resulting from changes in intention. Both in an initial study (n=105) as well as a replication study (n=82), children responded correctly over 75% of the time. While 5-6 year olds performed significantly worse than older children ($p < 0.001$), performance was still well above chance (~70% accuracy). In a final follow-up (n=120; ages 4-6) we explored whether the joint presence or absence of object labels and information about the historical context in which institutional objects were created would affect children's performance. However, performance was uniformly high (>80% accuracy) with no clear condition effects. Our findings suggest the ability to understand the role of collective intention in the function of institutional objects emerges much earlier than previously claimed. Even 4 year olds recognize function changes resulting from changes in collective intention—although this understanding becomes more robust as children enter middle childhood.

## PB-28 Infants recruit disjunctive inferences to disambiguate others' choices

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Complex propositional thought often involves integrating different knowledge domains and forming abstract representations relying on logical operations. Studies suggest that infants use logic to resolve uncertainty in physical and social world (Cesana-Arlotti et al., 2018; 2020), and may attribute disjunctive mental contents (Kovacs et al., 2021). Here we investigate whether infants can flexibly integrate logical and mental state reasoning for cross domain inferences. We ask whether they can employ contextual goal representations (i.e. from A and B an agent prefers A; but prefers B from B and C) and disjunctive inferences to identify ambiguous choice alternatives. Forty-eight 18-month-olds watched 8 Familiarization movies, aiming to induce contextual goal representations. In these, an agent reached behind an occluder and chose a car over a ball (A>B); and a ball over a clock (B>C). In Test, only the ball (B) was revealed, while the other side was underspecified to the participant (but not the agent): it could be the car or the clock (A or C, Fig1). Afterwards the agent reached behind one occluder. To interpret the choice, participants could apply disjunctive inference and resolve the uncertainty (e.g., the ball was NOT CHOSEN, THEREFORE the other (chosen) object must be the car). Then the objects were revealed -consistent or inconsistent with these inferences - and we measured infants' looking time. 24 participants saw "easy-contrast" alternatives (B vs. C, "easy" because C was never preferred in familiarization), the rest saw "hard-contrast" alternatives (A vs. B, each preferred in 4 trials). In each group, infants looked longer when the object-pair was inconsistent with the disjunctive inference they could make compared to consistent outcomes (Fig2). This suggests that infants flexibly rely on logical and mental state reasoning, representing others' goals in a format that allows interfacing with logical inferences, consistent with an early Language of Thought.



## PB-29 Word-final minimal pair learning by 14-month-old infants: Using of coarticulatory cues

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Discrimination of the consonant place of articulation contrast in word-final coda position (bat vs back) is acquired late compared to word-initial consonants (Swingley, 2005). Multiple acoustic-phonetic cues code the place contrast, but their informativeness heavily depends on the coarticulatory context or the particular vowel-consonant combination: formant trajectories (reflecting dynamic coarticulation) in the vowel preceding the /p-t/ final place contrast are qualitatively more similar for /i/ (e.g., heap-heat) than for /u:/ (hoop-hoot), which increases perceptual confusion (Ohala & Ohala, 1998). Similarly, cue strength of the burst (reflecting articulator position) differs across contexts (Walley & Carrell, 1983). Infants' use of different cue types in word-learning is not yet well understood, particularly for coda contrasts (Nazzi & Bertoncini, 2009). Using the habituation-switch procedure,

the current study compares infants' (N=40, mean 13.5 months [range: 13.3-14.9]) learning of object-label associations for the non-word pair /ba:p-ba:k/ — a context where both formants and burst are presumably informative— in conditions of differing cue availability during habituation. Experiment 1's habituation phase included exemplars from 10 speakers containing only the formant cue and no burst, while Experiment 2 included both. Test phases were identical and included both cues. We compared looking times when the object-label pairing during habituation was switched at test versus when the object-label pairing remained the same. In the two test trials following habituation, infants in Exp. 1 looked significantly longer to the Same than to the Switch pair (11.9s vs. 9.7s), whereas infants in Exp. 2 showed the opposite pattern (Same: 5.7s, Switch: 9s). The unexpected direction of the effect in Exp. 1 could be caused by the presence of the burst at test that was missing during habituation. Overall, the results indicate that infants are able to learn minimal pairs using a single acoustic coarticulatory formant cue.

## PB-30 "To generalize or not to generalize?" Exploring children's inferences about information encountered in game episodes

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In this study, we aim to explore whether children differentiate between novel properties of an object that are introduced as pretend and those that are introduced as actual properties. We plan to uncover if they would infer that the actual property they have just learnt themselves could be shared by those who were not part of the game, while the pretend properties are not. During the experiments, children play together with an experimenter and well-known objects. Two play episodes are connected to each object: the first corresponds to the canonical function of the object with a given prop, while the second involves novel information about the object with another prop. The experimental manipulation is whether these games are introduced as "real" or "pretend". These happen in the absence of a second experimenter, who decides to play with the object following the game episodes, and asks for a "missing" prop. We measure how children interpret this request by recording their object choices. Our prediction is that in case the property is introduced as an actual property, more children would select the prop corresponding to this novel property. In the other condition, we predict the pattern to be the opposite. The data collection is still ongoing (n = 56, aimed sample size = 60), but the pattern of results points in the predicted direction: in the pretend condition, more children select the prop corresponding to the canonical function of the object compared to the novel prop (60% vs 40%, respectively). The pattern is the opposite in the real condition, but the difference is smaller (44% vs 56%).

## PB-31 Toddlers' signature gaze-patterns of recognizing joint attention as third-party observers

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To establish that infants represent joint attention to an object with a social partner, previous research relied on infants' gaze-shifts between their partner and the object. Contributing to a growing movement in developmental research calling to study social cognition and learning beyond child-directed interactions, we investigated whether toddlers show similar signature gaze-patterns as third-party observers of others' joint attention. Such markers could serve as a valuable diagnostic tool for examining an observer's representation of third-party joint attention. We tested 36-month-old toddlers (N=36) in a novel eye-tracking task. The procedure comprised two phases. In the induction phase, we primed different degrees of interpersonal sharedness to be seen in the upcoming test phase, using videos of two actors in three conditions: joint attention, parallel attention, and control. Interpersonal sharedness was manipulated verbally (voiceover) and visually (actors' body orientation). In the subsequent test phase, toddlers saw images featuring the actors looking at a toy. The images were conceptually identical across conditions and ambiguous regarding interpersonal sharedness. To investigate if toddlers would seek different information in the test scenes following the sharedness manipulation, we analyzed their gaze-patterns using subsequences of consecutive AOI-hits. Preliminary results based on descriptive data suggest differences between the joint and parallel attention conditions: more triadic gaze-shifts between both actors and the target in the joint attention condition and more off-screen distraction in the parallel attention condition. Toddlers' gaze-patterns in the control condition were partially similar to the joint attention condition, suggesting a possible default assumption of joint attention. Our findings support the idea that toddlers' representation of third-party sharedness can indeed be inferred from their gaze-patterns. At the conference, we will present the final results and give an outlook on a planned comparative study with human infants and chimpanzees exploring the origins of joint attention using the developed approach.



## PB-32 Social cognitive shift: Implications of children's reflective abstraction

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How children represent and know the world drastically shifts around age 4 with the development of epistemic reflection (Bickhard, 1992). Prior to this development, children know the world through direct interactions in social situations. Therefore, the ability to navigate social situations is based on their prior history of shared practices (Mirski & Bickhard, 2021). The development of reflection enables explicitly representing social situations (Allen & Bickhard, 2018) as well as other abilities like appearance-reality, seriation, and logical negation (LN). From the interactivist perspective, negating

a social reality is the basis for deception. While studies have shown that theory of mind (ToM) is associated with deception (e.g., Talwar & Lee, 2008; Talwar et al., 2007), they tend to overlook epistemic reflection, and LN has not been studied in such a context. The current project aimed to investigate how the development of reflection changes the effects of ToM and LN for deception. The sample was 132 children aged between 2 years 10 months, and 7 years. Reflection was assessed through the leaning blocks task (Allen & Bickhard, 2018). ToM was measured through false-belief understanding by unexpected-contents (Gopnik & Astington, 1988) and change-of-location (Perner et al., 1987) tasks. Deception was evaluated using the temptation resistance paradigm (Talwar & Lee, 2008). Negation was measured with a picture-sentence verification task (Müller et al., 2005). The day-night task (Gerstadt et al., 1994) was used to measure inhibition. Analyses showed that initial lying was predicted by negation, but this effect disappeared when reflective and pre-reflective children were analyzed separately. However, both ToM and LN predicted semantic leakage control only for children who succeeded in the reflection task independent of age and inhibitory control. Results indicated that the development of reflection changes how ToM and LN influence deception and, hence, the manipulation of social situations.

## PB-33 Is sense of rhythm associated with numerical skills?

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While musical and general cognitive skills have been found positively related (e.g., Román-Caballero et al., 2018), the relationship between musical and mathematical skills is less clear (e.g., Román-Caballero et al., 2022; Vaughn, 2000). Moreover, the specific relationship between sense of rhythm and numerical cognition remains largely underexplored. Perceiving and (re-)producing rhythm, defined as a pattern of variable tone durations within a timing framework of beats (Frischen et al., 2022), potentially shares cognitive processes with numerical tasks such as counting, estimating, and proportional reasoning. Both kinds of processes include temporal processing, pattern recognition, and sequencing (e.g., Vanluydt et al., 2021). Studies examining the relationship between sense of rhythm and numerical abilities are rare and suffer from methodological shortcomings (e.g., Da Silva et al., 2017). The current study will investigate this relationship in non-musician adults through computerized tasks. German-speaking adults (N = 104) will complete rhythm recognition and rhythm reproduction tasks, as well as two numerical cognition tasks (i.e., Number-Line Task & Dot-Number Task). The potential relations will be investigated by regression analyses, in which we will statistically control for general cognitive factors such as intelligence and executive functions, which are known to be related to numerical skills (e.g., Hoard et al., 2010), and for demographic variables like SES, length of prior involvement in musical training, and age. This is an ongoing project: we will complete data collection by October 2024 and present the full results at the conference. The current study will contribute to a more nuanced understanding of the connections between music and mathematics, potentially identifying sense of rhythm as a key factor in numerical cognition. This research could

offer new directions for future studies and interventions that utilize rhythmic activities to enhance numerical skills across different age groups including children.

## PB-34 Do infants use cues of saliva sharing to infer close relationships? Replication of Thomas et al. (2022)

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Thick relationships (also referred to as close relationships or communal-sharing relationships) constitute a small set of social ties that are typically, but not always, observed in close kins. These relationships are characterized by mutual commitment and responsiveness, strong attachment between individuals, and a feeling of unity. Thomas and colleagues (2022; Science) reported the findings of several experiments showing that, when observing third-party interactions, infants, toddlers, and children exploit 'saliva-sharing' behaviors as cues for inferring the presence of thick relationships. To test the replicability of these findings, we attempted to replicate the main experiment of this study with the youngest age group. Our experiment used the original stimuli and the original design, but instead of running the study online and coding gaze direction manually from video recordings, we tested infants in a laboratory and measured gaze behavior by an eye tracker. We presented 8.5- to 10-month-old infants (n = 50, after exclusions) with videos of two actresses engaging in saliva-sharing and non-saliva-sharing activities alternately with a puppet. In the test phase, when the puppet expressed emotional distress, we measured which actress infants looked at first and for a longer duration. Our replication resulted in partial success: we replicated looking-time preference for the saliva-sharer ($BF_{10}$ = 13.62), but did not replicate the tendency to look first to the saliva-sharer upon observing the puppet's distress ($BF_{01}$ = 3.05). These findings confirm that infants rely on certain behavioral cues for mapping social relationships among third-party individuals, and point to the importance of choosing reliable and replicable measures in infant research.

## PB-35 Attitude understanding and irony development: Methodological challenges

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Verbal irony is widely recognized as involving attitude expression, particularly a dissociative stance where speakers distance themselves from an attributed thought that they find absurd or irrelevant. Ironic attitudes can vary greatly, encompassing everything from amused tolerance to different levels of dissatisfaction, skepticism or disdain (Wilson & Sperber, 2012). Furthermore, they are implicit and require pragmatic inference to be understood. Attitude comprehension thus represents a crucial, but arguably understudied, aspect of irony acquisition in children. This paper addresses two key

methodological issues in developmental irony research. First, it highlights how existing measures of attitude understanding often conflate it with other components of verbal irony, such as recognizing the speaker's intent or the interactional functions of irony (e.g., praise or criticism). Second, it explores the inconsistency of experimental stimuli used in irony comprehension tasks, including variations in familiarity, structural complexity, social context, and speaker/addressee characteristics. This inconsistency is problematic, as these factors can bias children's interpretation towards specific attitudes, without accounting for their distinct developmental pathways. These challenges have hindered the ability to trace a clear developmental trajectory for children's understanding of irony. By addressing these issues, the paper aims to reinterpret available data on irony development and refine methodological approaches, ultimately enhancing the precision and validity of empirical research on irony development.

## PB-36 Expanding essentialist beliefs to include everyone can counteract racial prejudice: Evidence from Singapore and the USA

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From as young as 4-5 years old, children often express essentialist beliefs about race and nationality, viewing each as causally powerful and stable over time and often associating national identity with a specific race. However, expression of these beliefs is often applied asymmetrically across different social groups, which may explain negative downstream effects, like prejudice against outgroups (Diesendruck, 2021). We recently found that American adults who essentialize "Americanness" more in phenotypically White vs. Latine Americans, correlated with negative stereotypes and support for harsher immigration policies against Nonwhite Latines, but those who applied essentialist beliefs equally do not. Do these patterns emerge in children, in both individualistic and collectivistic cultures? Here, across a sample of 5-12 years-old American children (n = 112), and an ongoing sample of 5-10 years-old Singaporean children (n =110) we find evidence that expanding essentialist beliefs to include racially-minoritized groups can counteract negative stereotyping and racial prejudice and discrimination. First, Singaporean children are more likely to essentialize racial-majority groups compared to racial-minoritized groups children (e.g., Chinese Singaporeans vs Indian Singaporeans) than American children (e.g., White Americans vs Nonwhite Americans). Second, across both cultures children who apply essentialist beliefs equally showed a reduction in negative stereotyping and support for more inclusive immigration policies to include racial minorities. Lastly across both cultures, both positive affect and exposure towards racial and national outgroups predicted essentialist beliefs, indicating these cognitive heuristics to be malleable attuned to children's inputs. These findings illustrate the importance of investigating the development of cognitive precursors to prejudice through an intersectional perspective and offer an exciting framework for future cognitive developmental research.

## PB-37 New perspectives on joint commitment in pretend play

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The study of pretend play has significantly advanced our understanding of the development of joint action in childhood, and more specifically children's early sensitivity to joint commitment (Rakoczy, 2006; Tollefsen, 2005). However, twenty years after these seminal contributions, joint commitment in pretend play is still primarily conceived as related to the enforcement of the constitutive rules of pretend games via partner control. By conceptualizing joint commitment both as a product and as a process (Bangerter et al., 2022), we propose a new theoretical framework that expands the scope of joint commitments undertaken via pretend play and focuses on how these are formed and sustained in interaction. First, looking at joint commitment as a product, we argue that pretend play also gives rise to a social commitment to act together, thus fostering social cohesion. This has important methodological implications. So far, studies have mostly focused on the strategies used to regulate joint action via partner control (e.g., rates of protest, re-engagement after defection). However, incorporating measures of partner choice could offer a more nuanced understanding of the feeling of joint agency and affiliative bonds that emerge via joint action (Fernandez-Castro & Pacherie, 2021, 2022). Second, looking at joint commitments as a process, we propose to reinterpret experimental evidence indicating that the exchange of communicative cues such as social gazes and smiles is enhanced in pretend vs. instrumental play (Striano et al., 2001; Rakoczy et al., 2005; Randell & Nielsen, 2006). These signals, typically interpreted as markers of 'just pretend,' may also play the crucial role of co-building the social commitment to act together. Overall, we suggest looking at joint commitment not only in the light of the development of normativity in joint actions, but also as a key developmental process in the formation and maintenance of social bonds during childhood.



## PB-38 Information anticipation and its relation to eye blinks among young children

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The feeling of "wanting to know" increases when people encounter uncertain or ambiguous information stimuli (Loewenstein, 1994). Specifically, it has been suggested that curiosity rises when individuals face ambiguous or partially clear information, often described as "tip-of-the-tongue" moments (Litman et al., 2005). Previous research has shown a link between curiosity and dopaminergic neuromodulation (e.g., Gruber & Ranganath, 2019), with spontaneous eye blink rate thought to represent dopamine activity (KARSON, 1983). However, it remains unclear how curiosity levels change during the information acquisition process and whether eye blinks are related to information acquisition in young children. To address this, the current study examines when spontaneous eye blinks increase during the information acquisition process among preschoolers using an exploratory

task. In this study, 44 preschool children participated in a task (the fish task) (Jirout & Klahr, 2012). During the task, we recorded spontaneous eye blinks. The fish task is divided into four phases: the new information phase, the decision-making phase, the information waiting phase, and the information acquisition phase. In this task, children were shown two windows and instructed to choose which one to open. Before opening a window, they were shown several possible fish choices (new information phase). They then declared which window they intended to open (decision-making phase). After a short delay (information waiting phase), they saw the fish corresponding to the chosen window (information acquisition phase). For our analysis, we examine whether there is a relationship between the information search phase and spontaneous eye blink rate. Analysis is currently in progress.

## PB-39 Do dogs with a vocabulary of object labels require temporal continuity to form object label mappings?

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At 18 months of age, toddlers have the socio-cognitive skills to identify the intentions of others and can use this to detect the reference of a novel label, when an object and a label are presented without temporal contiguity (Tomasello, Strosberg, and Akhtar, 1996). Dogs with a vocabulary of object labels (Gifted Word Learner dogs; GWL) can rapidly acquire new object-label mappings but the mechanisms with which they do so are unknown. The current study examines whether GWL dogs can form object-label mappings when the two stimuli are presented in temporal discontinuity. The dogs observe as their caretakers place a toy inside a bucket. While the toy is not visible to the dog, the caretaker repeatedly says its name embedded within sentences (e.g., “this is <Toy A>”) and alternates their gaze between the dog and the bucket, for one minute. These one-minute-long interactions are repeated twice a day, for 4 days, after which the process is repeated with a second toy. The dog’s knowledge of the two new labels is then tested by placing both objects on the floor, out of the caretaker’s view, and asking the dog to retrieve each of them seven times in a semi-random order. Preliminary results (N=1; binomial test, chance level=0.5, p=0.03) demonstrate that a GWL dog was able to form new object-label mappings even when the two stimuli were presented in a sequence that violates typical associative learning procedures. These results suggest that while forming new object label mappings GWL dogs are not only relying on associative learning mechanisms but may also be interpreting the communicative intent of their caretakers. Six additional dogs are in testing and data collection will be completed before the conference.

## PB-40 Young children's reasons for helping and reason giving

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Why do infants in their second year of life start to help others achieve their goal (Warneken & Tomasello, 2006)? We provide new insights in the cognitive mechanism behind this interesting phenomenon. In our experiment, N = 63 children between 16 and 42 months (M = 28.17, SD = 5.99) participated in three instrumental helping tasks (adapted from Hepach et al., 2017; Svetlova et al., 2010; Warneken & Tomasello, 2006) and a justification task (Király et al., in prep). We investigated when children started to help a clumsy experimenter by handing her a needed object (i.e., a pen, a toy animal, and wrapping paper) and when they started justifying their behaviour if they could not give the experimenter her favourite snack. According to teleology theory (Perner & Roessler, 2010), both behaviours should appear together, as both are grounded in our folk psychological understanding of actions: We see intentionally acting people (including ourselves) as acting for reasons (people do what they have reason to do). For example, if the experimenter is drawing something, she must have good reasons for doing so, and finishing the drawing is a desirable goal. If she accidentally drops her pen, the teleologist child has reason to pick it up and hand it to the experimenter so that she can finish the drawing. Similarly, if the child knows of a protagonist's favourite snack, she has good reason to give it to her when being asked for food. If this is not possible, however, the teleologist child should feel compelled to justify why she cannot provide the most desired. And indeed, the two developments were closely related: there was a clear and specific correlation between children justifying and helping (*rb* = .51, p < .001), which remained significant after controlling for age (?? = .39, p = .047).

## PB-41 Children's curiosity about how much a partner values them

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To navigate social interactions, people have to gauge whether a partner is likely to act cooperatively towards them, even if doing so is costly. A recent study by Quillien (2023) found that people preferentially seek out information that can reveal a partner's welfare-tradeoff ratio (WTR), a variable that determines how decision-makers trade off their self-interest against another's welfare. Here, we conceptually replicate this study with a sample of 6- to 12-year-old children (planned n = 96; preregistration: https://osf.io/cq2ah/?view_only=3d1e84af8dd54d11b65db9b27d806697), to assess whether they, like adults, are adept at pursuing relevant information about an interaction partner. Children play a resource allocation game (the "welfare-tradeoff task", WTT) with a partner, who can allot rewards either to herself or to the child. The decision options are visualized on cards. Before the test phase, participants are shown the outcomes of two somewhat selfish vs. generous decisions (between-subject manipulation). Across 12 test trials, children choose for which of two cards they

want to reveal the partner's decision. When the cards differ in how much the potential decisions could inform children's estimate of the partner's WTR, we predict that children will select the more informative one, and that this differs by their prior WTR estimate (i.e., partner previously acted generously or selfishly). According to Quillien's (2023) "ideal search" model, to whose predictions we compare children's choices, participants are hypothesized to estimate others' WTR by inverting a causal model of people's behavior in the WTT, using Bayesian updating upon encountering new evidence ("ideal observer"). The expected information value of an outcome is quantified as the KL divergence between the ideal observer's posterior belief about the partner's WTR and its prior belief. Data collection is ongoing (current n = 26) and expected to conclude before the conference.

## PB-42 Are violations of spatial expectations parametrically related to pupil dilation and looking time responses in 12-month-olds?

Paul Gallenkemper, Nina-Alisa Kollakowski, Ulf Liszkowski
University of Hamburg, Germany

During repeated presentation, infants build spatial expectations about stimulus locations, as indicated by increased looking times when the stimulus appears in a different location (Haith et al., 1988). However, it is unknown whether their reaction amplitude is parametrically related to the deviation from the expected location, i.e. whether the reaction amplitude increased with deviation, as it has been shown in adults (Preuschoff et al., 2011). To investigate this, we will present 12-month-old infants with learning sequences of eight trials, in which a stimulus appears at the same random location on a circle. After each learning sequence, infants will see one test trial, in which a stimulus either appears at the expected location, or at a location 90°, or 180° away from the expected location. We will measure the pupil dilation response (PDR) in the learning phase and test trials. The PDR has been found to be parametrically related to deviations from expectations in auditory paradigms with adults (Marois et al., 2018) and toddlers (Tamási et al., 2017), and also has been shown to track prediction error in infants (Poli et al., 2024; Zhang et al., 2018). We therefore expect to find a stronger PDR to trials with 180° deviation compared to the trials with no deviation. PDR to trials with 90° deviation are expected to lie in between the two. We expect a similar pattern of results for looking times. Also, as a measure of learning, we expect a reduction of the PDR during the learning phase, as other studies have shown that PDR decreases with repeated presentation of stimuli (Polzer et al., 2023). This study builds on extensive prior pilot data in our lab. After preregistration, final data collection will take a maximum of two months (N=40) and analyzes will be concluded by the end of December.

## PB-44 The leech principle in irony processing – An experimental pragmatic test of a basic tenet in cognitive pragmatics

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Background: The research targets the complex developmental and neurocognitive aspects of irony and metaphor, highlighting their distinct social functions and cognitive underpinnings. Leech (1983) has completed the paradigm of the Gricean cooperative principle and hypothesizes a principle of irony not as a subordinate entity but as a principle on its own, suggesting that irony represents a higher order discourse strategy, in that it is characterized by a higher level of indirectness, and a weaker illocutionary force. Honest (impolite) opinion is conveyed indirectly in implicatures (false honesty), manifesting itself at a higher, metarepresentational level for which metarepresentation (mentalization) is also essential. Method: Our experimental study investigates preschoolers' linguistic performance with semantic and pragmatic tasks (simile, metaphor, and three irony trials: irony, irony with surface cue, control task). Success in the linguistic trials is viewed in relation to children's mentalization skills tested with an unseen displacement task and first- and second order False Belief Tests to see if ToM skills predict success in pragmatic competence. Findings: Results suggest that irony is interpreted considerably earlier than previously thought, (Gibbs 1994). Irony is interpreted by means of a compensatory strategy and through salient features or irony (Wilson 209, 2013), where context, intonation and a number of social-cognitive factors (ostensive signals and surface cues) contribute to the triggering of a short-cut strategy, resulting in social-cognitive biases and thus different heuristics as a shortcut to intended meaning (Csibra 2010), and early success in its interpretation. The findings support Leech's irony principle in that we investigate irony together with, but separately from the Gricean maxims, and next to, but not within the category of the infringement of the maxim of Quality. Results confirm that irony is not connected to any of the maxims, but stands out as a separate principle of its own (Schnell 2022, Schnell-Ervas 2024).

## PB-45 Auditory associative word learning in preschool and school children: Effects of modality-specific short-term memory and language development

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We experience the world in a multitude of perceptual modalities and name these experiences accordingly. However, a large proportion of the word-learning literature focuses on labeling visual objects. In this work, we focus on labeling environmental sounds. While infants are able to learn sound-pseudoword pairings (Cosper et al., 2020), young adults only indicate learning sound-pseudoword pairings under specific circumstances – when stimuli are presented simultaneously (Cosper et al., 2022) and when words precede sounds in sequential presentation (Cosper et al., 2024). In this ongoing work we investigate the potential developmental shift in such learning. We aimed to test 45

5-6-year-olds and 45 9-10-year-olds in a sound-pseudoword sequential associative word learning paradigm. EEG data were collected to assess word learning in an initial training phase (consistent vs. inconsistent pairings) and a subsequent testing phase (matching vs. violated pairings). Cluster-based permutation test analyses will focus on the N400-like effect in a typical time window (400 – 800 ms) and a late time window (800 – 1200 ms), while applying a signal detection analysis (d') of behavioral button-press responses for assessing accuracy in the test phase. Additional measures of language development (SET 5-10; Petermann, 2012) and three short-term memory recognition tests (auditory-verbal, auditory-nonverbal, and visual-nonverbal) were collected. While we assume word learning to occur in both age groups, we expect more infant-like effects for the younger children and more adult-like effects for the older children. Current preliminary results indicate no significant ERP effects in either the 5-6 (N = 24) nor in the 9-10-year-old (N = 28) groups in either the training or the test phase; however, behavioral results indicate evidence for word learning of the 9-10-year-olds in the testing phase. Ongoing data collection is being conducted to determine how age, short-term memory recognition, and language development influence auditory associative word learning.

## PB-46 The emergence of children's vigilance towards others' gullibility: A selective trust task

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Epistemic vigilance enables individuals to mitigate the risk of misinformation by assessing the trustworthiness of the source of the information and the believability of its content (Sperber et al., 2010). When direct access to the primary source of information is unavailable, people may rely on each other's vigilance to form beliefs. However, little is known of the human's capacity to monitor other's epistemic vigilance and use this information to guide belief formation – referred to as 'second-order vigilance' (Mazzarella & Pouscoulous, 2021). Previous research using a false communication task with a single gullible or vigilant informant found that children as young as 4/5 years old tend to trust a vigilant informant more than a gullible one, though a strong bias to trust the informant persisted in both conditions. To address this bias, we build on studies suggesting that children's sensitivity to unreliability cues may be heightened in selective trust tasks, where they compare reliable versus unreliable informants, rather than in tasks with only a single unreliable informant (Mascaro & Morin, 2014). In this pre-registered study, we use a selective trust task to examine the development of second-order vigilance in 4- to 8-year-olds (target sample: N = 128). Participants lack direct access to the primary information source (a deceptive puppet) and must choose between conflicting testimonies from a gullible informant and a vigilant one, both of whom had access to the deceptive puppet's testimony. We hypothesize that older children will increasingly favour the vigilant informant's testimony over the gullible one, and we aim to trace the specific developmental trajectory of this ability.

## PB-47 Naïve utility calculations in adults: Does pupil dilation conform to infants' looking time? Conceptual replication of Liu et al. (2022)

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Liu et al. (2022) found that 13-month-old infants could infer the value of a goal from the cost of the action taken to achieve that goal. In their study, N = 32 infants watched different scenes in which an agent approached one of two figures at a time, accepting higher action costs for figure A than for figure B. At test, when the agent could approach each figure at (almost) no cost, infants looked longer when she approached figure B. This was interpreted as surprise over the outcome (violation of expectation), because having accepted higher action costs for BA earlier suggested that they favor approaching BA over AB. We will replicate these findings in adults using pupillometry instead of looking time. If adults' response is similar to infants', they should show greater pupil dilation when the agent approaches figure B at test. By the time of the conference, we will have finished data collection to present our results.

## PB-48 "I was wrong, therefore I won't learn" - negative feedback hinders learning in 4- to 5-year-old children

Réka Schvajda, Száva Apáthy, Zsuzsanna Nemes, Ildikó Király

Eötvös Loránd University, Hungary

Being able to confront failure is crucial to learning from it. It has been shown that after negative feedback on a simple learning task, adult's performance dropped to chance (Eskreis-Winkler & Fishbach, 2019; 2022). Our goal was to explore how feedback affects children's learning performance. Our hypothesis was that children would learn regardless of feedback, because preschoolers' motivation to learn could outweigh the negative effects of failure. We created a child-friendly task based on the Facing Failure Game (Eskreis-Winkler & Fishbach, 2019). Children were introduced to an unfamiliar species (Zarpies). In the learning phase, the experimenter showed pairs of novel objects and introduced a novel label. For each, she asked the child to guess which object the Zarpies would label with that novel name. Children in the Success condition were told that they were correct and children in the Failure condition were told that they were wrong. In the test phase, children were shown the same pairs of objects and they were asked about the names of the objects again. Three novel names were introduced. Based on the first feedback, participants in both conditions could be able to deduce the correct answer. Our results showed that there was a significant difference between the Success and the Failure conditions ($t(58) = -4.32$; $p > .001$). Children in the Success condition performed significantly better than participants in the Failure condition. Moreover, children in the Success condition exceeded chance level ($M=2,53$; $SD=0,89$) ($t(29) = 6,2$; $p > .001$). Meanwhile children in the Failure condition performed at chance ($M=1,46$; $SD=1,00$) ($t(29) = -1,81$; $p = .858$), which indicates that they did not learn. Our results confirm that children are not protected against the negative cognitive and emotional effects of failure and struggle to learn after negative feedback.

## PB-50 How early motor system development promotes spatial navigation - an infant investigation

Sayani Banerjee, Moritz Köster
University of Regensburg, Germany

Infants' early motor development has significant implications for perception. For example, the transition from crawling to walking may influence spatial navigation (Clearfield, 2004; Newcombe, 2019). Studies have shown that grey matter volume, particularly in the hippocampus and cerebellum, increases substantially during this period, for example when compared to white matter maturation (Bethlehem et al., 2022; Knickmeyer et al., 2008). Additionally, sensorimotor networks in the first year of life exhibit functional connectivity at par with adults. However, structural and functional neural developments underlying early spatial navigation in infants remain poorly understood, and neural correlates of motor system development at this age need to be more closely investigated. This study explored two main aspects of infant early motor system development. First, the developmental trajectory of the infant brain, focusing on maturation of motor cortical and medio-temporal areas between 6 and 24 months. This analysis of developmental trajectories is based on ~200 anatomical brain images from the dHCP (developing Human Connectome Project) dataset. Second, we investigate how infants' motor abilities at 12 months (n=84) influence their spatial navigation skills, potentially mediated by increased volumes in brain regions associated with spatial navigation, such as sensorimotor cortex, hippocampus, and vestibular cortex. Combining motor tasks, resting state MRI scans, and a behavioral spatial navigation task (i.e., a hide-n-seek task with the mother), revealed that motor skills were positively correlated with spatial navigation abilities ($r(46) = 0.30$, $p < .05$) and the relative voxel size of motor regions ($r(29) = 0.39$, $p < .05$) and the hippocampal formation ($r(29) = 0.38$, $p < .05$). However, our mediation model was not confirmed in this preliminary analyses. These findings are a first step in a better understanding of the neural underpinnings of motor system and hippocampal development and its consequences on spatial cognition.



## PB-51 Evaluations of stealing in childhood: Examining the influence of harm and authority

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Stealing – or taking without permission - is described as a prototypical moral violation (Gray & Graham, 2019). Yet, there are striking instances where stealing is judged acceptable or even encouraged (e.g., Robin Hood). Social Domain Theory (Turiel, 1983) posits that moral violations are distinct from conventional violations in that they are wrong across individuals and context. Building on our recent work with adults demonstrating that judgements of stealing are affected by the authority status of the taker, and whether the taking causes harm, this study examines these influences on children's judgements of taking without permission. 68 8-year-olds (M 95.72 months, SD 6.08, 41% female)

participated in a preregistered study. Participants viewed classroom-based vignettes where one child lacked a required resource (e.g., a pencil), and another individual took from another student without permission to address the need. We varied the authority status of the taker (teacher/peer) and harm to the original owner (harm present/absent). Participants then made judgments on a 6-point Likert-scale about whether: i) the act was stealing, ii) the act was acceptable, iii) the prohibition generalized to a new context. Finally, participants provided justifications that were coded as moral (e.g., harm/fairness) or conventional (e.g., rules). Consistent with adults, analyses based on Linear Mixed Effects Models indicated that children were sensitive to both the authority status of the taker and the presence of harm (p's < .01, $\eta_2^p$ 0.11–0.53). When a peer (vs. teacher) took the resource, participants were more likely to label the act stealing and evaluated it as unacceptable. Similarly, when harm was present participants judged the act as less acceptable, and more generalizable. Together, these results suggest that stealing is not a de facto moral violation but that starting in childhood, individuals are sensitive to context when evaluating acts of taking without permission.

## PB-52 Children adapt how they communicate rules based on different social contexts

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Technical University of München, Germany

From an early age, children learn normative and causal rules, enabling them to navigate their surroundings effectively. As their social cognitive abilities develop, they increasingly learn and transmit rules through communication with peers, ensuring shared understanding and cooperation. Previous research indicates that, in cooperative contexts, children support one another by offering reminders and clarifications (Koymen et al., 2016). However, this communicative approach may change in competitive contexts, where children might withhold information to gain a competitive edge. Our study aims to explore whether and how children's communication strategies for sharing learned rules differ based on whether they are in cooperative versus competitive social contexts. In a tablet-based study, we asked 4- to 11-year-old children (target n=90) to help feed an alien character. The children first learned what the alien likes and dislikes (i.e., only likes pink objects). They were then asked to share what they had learned about the alien's food preferences with a virtual peer, introduced as either a teammate (cooperative condition: rewards would be combined) or a competitor (competitive condition: competing for rewards). Children had to choose whether to share the correct rule (e.g., only pink objects), an incorrect rule (e.g., blue objects), or indicate that they did not know. Preliminary analyses (n=77) indicate that children are more likely to communicate the accurate rule in the cooperative condition compared to the competitive context. However, the condition effect was stronger for older children, as about half of the younger children communicated the accurate rule even in the competitive condition. These preliminary results suggest that children flexibly adjust their information-sharing strategies depending on the social context.

## PB-53 Factive vs. non-factive mentalization in infants

Anna Kispál, Ágnes Melinda Kovács
Central European University, Austria

While a great body of research targets belief and knowledge attributions, few studies target how different mental state attributions relate to each other (Phillips et al, 2021). Here we aim to explore whether factive (e.g. knowledge) and non-factive (e.g. belief) mental state computations recruit similar representational structures within one system or different ones belonging to separate systems. Analogously to findings with adults, we study the relationship between factive and non-factive mentalization by examining the way updates happen between them, relying on the assumption that update within one system should occur faster than between systems. That is, if factive and non-factive mentalization belong to the same system, updating a non-factive to another non-factive mental state (non-switch condition, e.g. false belief to true belief), should be easier, than updating from a non-factive to a factive mental state (switch condition, e.g. false belief to knowledge). In our eye tracking experiment 19-month-old infants will watch animated videos of an agent who is following the movement of a ball that can hide in one out of two boxes. The agent's mental states about the whereabouts of the ball will be manipulated. For instance, first the agent has a false belief, but then the scene changes, resulting in a knowledge (switch condition) or a true belief (non-switch condition) attribution. At the end of the videos the ball will be revealed and saccadic reaction (SRT) to the reappearance of the ball will be measured as a proxy to the ease of the update. We expect that SRT should be faster in the non-switch condition in case factive and non-factive mentalization belong to two separate systems. Results from a previous experiment with adults showed that SRT was significantly faster on non-switch trials than on switch trials. Results from infants will be presented at the conference.



## PB-54 Intergroup attitudes in preschool children in conflictual intergroup settings: The case of Romania and Lebanon

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This project explores the development of intergroup attitudes in preschool-aged children (ages 3 to 6) from two conflict-ridden countries, Lebanon and Romania, where ethnic tensions are prevalent. Specifically, it examines how children from high-status groups (Lebanese and Romanian) perceive members of their ingroup, a stigmatized outgroup (Syrians in Lebanon and Roma in Romania), and a high-status outgroup (French children). We employed a physical distance task and a friendship task to measure intergroup attitudes. In the first study, 94 children (30 from Romania and 64 from Lebanon) responded using different photographs depicting each group, labeled according to the group they represented. Regardless of age, the results revealed a consistent pattern across Lebanese and Romanian children. Children from both groups showed more physical closeness and were more

likely to choose French children (the high-status outgroup) as potential friends. In contrast, they maintained greater physical distance and were less likely to choose friendship with members of the stigmatized outgroups (Syrians in Lebanon and Roma in Romania). In a second study, we replicated our findings with 87 Lebanese children aged 4 to 6. This time, we used the same six photographs for all groups, randomly labeling them as belonging to the ingroup, the stigmatized outgroup, or the high-status outgroup, to test whether the labels alone influenced the children's responses. Interestingly, we found that children displayed more physical closeness toward ingroup members rather than the high-status outgroup. However, the stigmatized outgroup remained the furthest group and the least chosen as friends. These findings lead to two important conclusions: first, as young as 3, children in conflict-prone environments display strong biases against stigmatized groups; second, the way groups are presented can significantly affect the outcomes, highlighting the importance of controlling for visual and contextual cues in studies of intergroup attitudes.

## PB-55 How do children evaluate informants when unsure of reality?

Cyann Bernard, Adeline Depierreux, Olivier Mascaro

Université Paris Cité, CNRS, Integrative Neuroscience and Cognition Center, France

Learners often face the challenge of deciding whom to trust without direct means to verify the accuracy of informants' claims. This study investigates how children address this issue. We hypothesize that when facing uncertainty about reality, children can use decision confidence to infer the reliability of information sources. Specifically, we assume that children can assess informants' reliability by monitoring the agreement between their beliefs and an informant's testimony, weighted by their initial confidence in those beliefs. Our experiment tested 183 children aged 3 to 10 years. During familiarization trials, participants had to decide whether there were more blue or yellow dots in a flashed image. To manipulate children's confidence, the ratio of yellow to blue dots varied, creating three between-subject conditions of increasing difficulty (easy, intermediate, and hard). To manipulate agreement, each trial included responses from two informants. One always agreed with the child, and the other always disagreed. Participants did not receive any feedback on the accuracy of their own or the informants' answers. During the test phase, children had to decide which informant they would prefer to ask for help and whose answer they would endorse in a novel task. Data reveal that during the test phase, children showed a global tendency to prefer to ask and endorse information from the agreeing informant rather than from the disagreeing informant ($p < .001$). Importantly, this preference was modulated by condition, such that children's tendency to prefer the agreeing informant over the disagreeing one increased as the task became easier (estimate = -.33, $z = -3.25$, $p = .001$). Thus, the more confident children became, the more heavily they weighed agreement between their own answers and those of informants. These results indicate that when facing uncertainty about reality, children rationally integrate agreement and decision confidence to determine whom to trust.

## PB-56 Alphie: Social mobile agent to enhance children's socio-cognitive skills

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Children are spending an increasing amount of time with mobile touch screen devices which displaces time spent with developmentally important activities such as social interactions potentially hindering children's social-cognitive skills. To promote positive changes, we created Alphie, the social mobile agent which includes developmental games, encourages real social interactions and expresses emotions. In this study, we are interested in its success—its likability and effectiveness in enhancing children's socio-cognitive skills. Additionally, we endowed Alphie with a personality and assess whether success depends on its personality in general, a specific personality type, or the match between Alphie's and the child's personality. We hypothesize that certain personality types may be more successful regardless of the child's personality. Alphie's personality was designed and created based on the Big-5 Extroversion factor. An extrovert and an introvert personality were created which was expressed through inner states (gif, sound effects) and behavior (user reactions and actions). In the online experimental, longitudinal study, we included 6–8-year-old children (N=65). In a within – and between subject design, there were 3 groups: experimental group (Alphie with extrovert/introvert personality), control group 1 (Alphie without personality) and control group 2 (no Alphie). At three timepoints parents reported on children's digital and non-digital activities and children's socio-cognitive skills was tested with gamified touchscreen tests (Second-order version of Sally and Anne test, Icecream test, Faux pas test, Static facial display test and the Real and apparent emotions test). At baseline parents reported on sociodemographic information and children's personality (BFQ-C). In the final assessment, Alphie's likeability was tested using parent and child UX questionnaires. Between T1-T2, in the control month, we tracked children's daily device use through a logging app for a month. Between T2-T3, in the experimental month, children used Alphie based on their assigned group. Preliminary results are presented and discussed.



## PB-57 Decoding cultural influences on visual object categorization in infants

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[1]University of Regensburg, Germany; [2]Osaka University, Japan; [3]Freie Universität Berlin, Germany

Categorization — the ability to classify stimuli into distinct categories — is crucial to structure visual input and organize the visual world (Mareschal & Quinn, 2001; Grossmann et al., 2009; Hoehl, 2016). While infants already show the ability to categorize visual stimuli in their first year after birth (Xie et al., 2022), it remains an open question of how much of their early emerging representations are shaped by experience. Looking time studies suggest that familiarity affects infants' categorization performance already at four months (Kovack-Lesh et al., 2010). Yet, the impact of visual experience on categorization remain to be further explored. Here, we employ a cross-cultural approach to examine categorization

in infants at 5 and 11 months from Germany and Japan. To investigate categorization processes, we decode the categories from Japanese and German items from the EEG. Specifically, infants saw 36 images from five categories, with items reflecting either typical German or Japanese cultural contexts. We applied Representational Similarity Analysis to determine category decoding accuracy and its temporal dynamics. Preliminary results from 51 infants (full data from all 190 participants will be presented at the conference) suggest a clear difference in category decoding accuracy between culturally familiar and unfamiliar items for 11-month-olds, with potential differences emerging as early as 5 months. We will further present data on face processing of culturally familiar and unfamiliar faces to disentangle perceptual narrowing and perceptual learning processes. This study holds the promise to offer exciting insights into how early categorization is bound by culture-specific experiences.

## PB-58 Uncertainty in word-learning

Alan Langus, Barbara Höhle, Adamantios Gafos
University of Potsdam, Germany

The context novel words occur in influences how they are learned. Increasing the number of object-label pairs makes word-learning harder, while words encountered in varying auditory or visual contexts are learned easier. We hypothesize that these findings can be accounted for by the notion of Entropy. Entropy measures uncertainty and is higher in situations with more alternative events or where events occur with equal probability. While higher uncertainty makes learning more difficult for adults, the way uncertainty affects infants' word learning has not been directly tested. In Study 1, we therefore tested the effect of uncertainty on word-learning by varying the probability distribution of the object-label pairs to be learned. 2-year-old infants (N-48) were familiarized with three object-label paris that occurred equiprobably (Higher Uncertainty) or with different probabilities (Lower Uncertainty). Crucially, in both conditions one object-label pair occurred the same number of times (e.g., Target). We show that infants' pupils dilated more to the Target object-label pairs in the higher uncertainty condition, suggesting that higher uncertainty in word-learning tasks requires more cognitive resources. In Study 2, we tested the effect of uncertainty by varying the number of possible alternative object-label mappings. 16-month-old infants (N=50) were familiarized with 2 object-label pairs uttered by 8 males and 8 females. Crucially, the gender and the auditory labels could be fully correlated with objects (more possible object-label mappings = Higher Uncertainty) or only auditory labels could be correlated with the objects (fewer possible mappings = Lower Uncertainty). Infants' looking-times to the correct object at test varied as a linear function of uncertainty, with lower uncertainty in the familiarization phase leading to stronger looking-time preferences at test. Our results show that infants behavioral and physiological responses vary as a function of uncertainty in word-learning tasks, suggesting that words are learned better in predictable situations.

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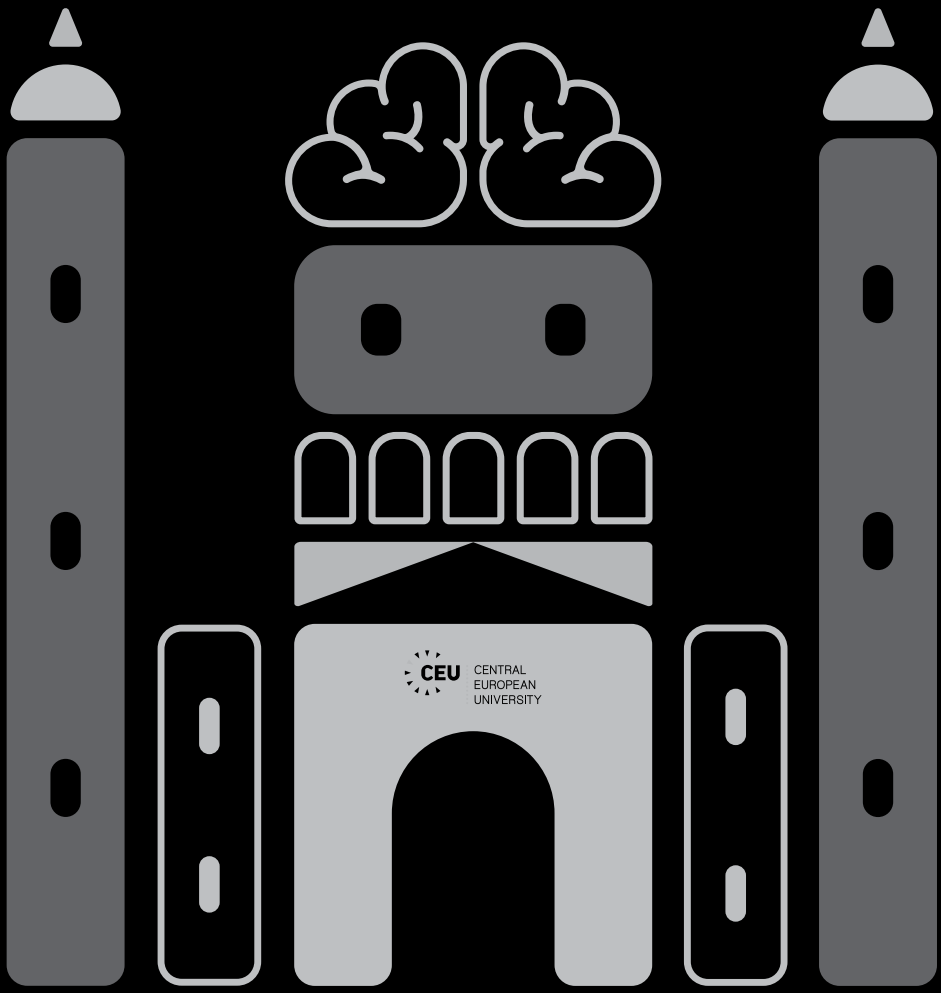

# POSTER SESSION C: SATURDAY

## PC-01 The development of observational learning of causal action sequences in 1- to 5-year-olds

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Successfully navigating the world requires understanding complex causal relationships. Young children's ability to learn causal action sequences—e.g., that you need to first turn a dial and then press a button to get a sticker—is currently unclear. This study aimed to investigate the development of the ability to infer via observation when a sequence of actions is causally necessary (N=231 1- to 5-year-olds). Children watched a demonstrator interact with two actions A and B (e.g., dial, button) on a sticker-dispensing puzzle-box, then had the opportunity to interact with the box themselves to obtain up to 5 stickers. Children were assigned to one of two conditions: sequence necessary (SN) or sequence unnecessary (SU). In the SN condition, children saw evidence that action A followed by action B (AB) led to a sticker being dispensed, whereas action B alone did not (AB sequence is causal). In the SU condition children saw evidence that both AB and B alone resulted in a sticker (B is causal). We coded children's number of successful activations (1-5), and for each activation whether they first acted on A (sequence) or B (non-sequence). For number of successful activations, there was a significant interaction between condition and age (linear regression: $t=4.21$, $p<0.001$): success was high across the age range in the SU condition, but increased with age in the SN condition. Age was a significant predictor of children's tendency to act on A first (produce sequences; $t=4.31$, $p<0.001$), and children were more likely to touch A first in the SN than the SU condition, but not significantly so ($t=1.80$, $p=0.07$). These findings suggest that the ability to infer when a sequence of actions is causally necessary based on observation is continuing to develop across early childhood. Ongoing video coding is enabling a finer-grained examination of children's behaviour.

## PC-02 Attributing false beliefs leads to altercentric biases in preschool children's search for objects

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Humans possess a unique ability to understand the thoughts and beliefs of others. This extends to a point where other people's beliefs may influence us even when they hold no relevance to our current tasks. Such interferences, known as altercentric biases, have been suggested to reflect automatic belief processing and have been observed both in adults and preverbal infants. Here, we asked how altercentric biases develop as children acquire the ability to explicitly reason about others' beliefs in classic false belief (FB) tasks, and how they interact with explicitly reasoning about the others' belief.

In two preregistered experiments (N=75 and N=40), we asked 3- to 5-year-old children to search for an object in a continuous search space while an agent was present who had a false belief about the object's location. We found that only children, who were able to explicitly reason about an agent's belief in a standard FB task, deviated from the actual object location in direction of where the agent believed the object to be. That is, they showed an altercentric bias in their search for the object, whereas children who did not yet pass the explicit false belief task did not. In a follow-up experiment, we showed that this altercentric bias was further only present when children had been asked to explicitly reason about others' FB in a previous task, in line with recent findings in adults. While recent studies have shown altercentric biases in infancy that recede in the second year of life, our study indicates that altercentric biases may re-emerge as children begin to explicitly reason about false beliefs in the preschool years. Altercentric biases may then depend on explicitly reasoning about the belief of others, and the biases observed in infancy may differ from those observed in older children and adults.

## PC-04 Testing the limits of children's selective preference for generalisable information transmission

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Emerging literature on children's teaching shows that they select information for transmission based on information type and its recipients. Children preferentially share information that is generalisable to a kind ("dogs have fur"), rather than specific ("this dog has spots") (Gelman et al., 2008, 2013; Baer & Friedman, 2018; Cimpian & Scott, 2012). However, prior research focused on neutral information and systematic investigations into the extent and limits of such preference are lacking. Specifically, it is unknown whether generalisability preference is retained when information is affectively arousing, potentially threat-inducing, or health-related. Such saliency dimensions have been shown to affect children's selective social learning (Ronfard & Harris, 2018) but have not been explored in children's selective teaching. In four studies, using an interactive online paradigm, children aged 6-9 (N = 144, n = 36/study) were presented with generic and specific facts which were: neutral about animals (study 1), presented an implicit threat of evolutionary (e.g., snakes) or culturally acquired (e.g., germs) nature (study 2), health-related about animals (study 3), and health-related about humans (study 4). Following learning, children selected facts for transmission to a naïve agent. We coded the first choice and the total number of generic and specific facts shared. We expected a disruption of generalisability preference in non-neutral domains (studies 2-4). Study 1 conceptually replicated prior findings that children preferentially share generic information about neutral topics. Robust preference across both measures was also evident in studies 3 and 4, while study 2 instead found a null effect (Figure 1). These results challenge the assumption about the uniform nature of the value of information selected for transmission. Specifically, the implicit threat present in information seems to disrupt the generalisability preference in information transmission, while evidential health-relevant information is treated with preferential sharing of most socially valuable - generalisable - facts.

## PC-05 "It's okay to talk about fairness in our family." Chinese parental socialization strategies of unfair situations

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Parenting influences children's moral behaviors and shapes their norm understanding even at a very young age (Brownell et al., 2013; Song et al., 2024). Justice is a critical area of moral development. Children at different ages display different attitudes toward fairness regarding the type of resources to distribute, the principle of distribution (e.g., merit-based or pure equity), the status of the recipient (e.g., Rizzo et al., 2016; Elenbaas, 2019; Noh et al., 2019). While most research focuses on children's behaviors, limited studies have examined parental effect on fairness development. In this ongoing study, we aim to explore whether and how parents' socialization strategies differ in different unfair scenarios and its potential effect on children's fairness development. Online interviews are conducted based on hypothetical scenarios, where children are at an advantage or disadvantage on conditions: (1) scenarios involving reward versus punishment, (2) the unfairness was caused by a powerful figure versus a peer. A within-person experimental design is adopted, and orders are counterbalanced. Parents are asked to describe how they would respond under each circumstance, and their responses were coded following the coding scheme (see Table 1 for a preliminary version of the coding scheme). Preliminary simplified coding (N=40) shows that (1) Parents tend to justify more when the distribution is made by a powerful figure compared with a friend ($p < .01$) and when "bads" are delivered compared with "goods" ($p < .01$), no matter children is at advantageous or disadvantageous; (2) Parents educate their children not to concern about fairness more when punishment and unwanted materials are delivered compared with good things ($p < .01$), and this tendency is more robust when their children are at disadvantageous ($p < .01$). We plan to finish data collection by conference and will follow up their children's distributive behaviors later.

## PC-06 Influence of personal cost on children's prosocial responding

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Humans are unique in their tendency to act selflessly on behalf of others. Two common prosocial acts are instrumental helping (Warneken & Tomasello, 2006) and prosocial lying (Xu et al., 2010). While both helping and prosocial lying are common in childhood, they become less likely as costs increase (Sommerville et al., 2018; Popliger et al., 2011). Importantly, the costs associated with these two acts differ. Whereas, helping involves the expenditure of time and/or effort which can vary across context, prosocial lying always imposes a moral cost (i.e., violating rules around truthfulness). The current study examines the influence of cost on children's selection between prosocial responses. We are recruiting 120 7- to 9-year-olds in this ongoing, pre-registered online study. In the first part of the study participants are told they must win at least one round against a virtual, age-matched, confederate

to receive a prize. After the confederate loses all rounds, the participant has an opportunity to lie prosocially (i.e., say the confederate won when they didn't) or act prosocially (i.e., play another round). While the cost of lying is inherent in the act, the cost of helping is manipulated by telling the participants they are running low on time and might not get to play either a fun (high cost) or boring game (low cost). We hypothesized that children would be more likely to tell a prosocial lie when the costs of helping are high (i.e., sacrificing time playing the fun game). In contrast to past literature, and our hypotheses, prosocial lying was extremely uncommon. Few participants told a prosocial lie (10%), most (93%) played an extra round, regardless of cost. These results speak to the moral motivations underlying children's prosociality, demonstrating that they will incur a personal cost to avoid the moral costs of lying.

## PC-07 Novel avenues to explore non-verbal composition of complex logical structures: Reasoning from disjunctions and conjunctions.

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Disjunctions are at the core of the representation of alternatives. Several findings suggest that pre-verbal infants can draw disjunctive inferences when presented with scenes plausibly represented with simple disjunctions (Cesana-Arlotti et al., 2018; Ekramnia et al., 2022). In language, sentences involving disjunctions sometimes occur embedded in more complex structures. One such complex, containing conjuncts inside a disjunct "(a and b) or c" lead to systematic reasoning biases (Walsh and Johnson-Laird, 2004): adults accept as valid that "b" follows from "a", even if such a conclusion is invalid. One important question is whether this bias depends on the language of disjunction, or simply the logic of disjunction. We modified Chung et al.'s (2022) task that controls for linguistic and pragmatic effects, in an eye-tracker (ET) contingency paradigm suited to be tested in infants. Here we present its first adult validation prior to the ET implementation. In our scenes, water flows through pipes interrupted by gates. Physically they mimic the "(a and b) or c" structure. A pipe branches with two gates on one side (a and b) and one on the other (c), later merging again. In the infant study, gate "a" always opens, and gates "b" and "c" openings are contingent to infants looking behavior, which will reveal if these scenes induce the bias documented in (Walsh and Johnson-Laird, 2004). Adult results show that our visual stimuli elicited the same pattern observed with verbal materials, suggesting that such bias does not hinge on language. These studies might thus help reveal the nature of the mental representation of disjunctions, whether triggered by linguistic disjunction, or by the spontaneous representation of a conceptually disjunctive scenario. More generally, applying this design to infants will allow us to improve our understanding of how fundamental logical connectives arise and are represented.

## PC-08 The development of children's knowledge of social norms: A cross-cultural study

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Human sharing is likely to be at least partly shaped by culturally-specific social norms. Recent research suggests that during middle childhood children in some societies show an increasing preference for egalitarian resource distributions, but is this driven by the development of children's knowledge of their culture's social norms for sharing? To examine this, we conducted a resource distribution task with children aged 4-12 years living in the UK (N=163) and Uganda (N=189), along with their caregivers. Participants were presented with a choice between sharing tokens equally or unequally with a peer. Children and caregivers made normative judgements about which option (equal or unequal) they "should" choose, and children then made real choices. Across three scenarios we investigated whether participants would share equally when doing so cost nothing (Scenario 1), when doing so prevented a peer from gaining more than them (Scenario 2), or when doing so was personally costly (Scenario 3). This allowed us to explore participants' broader sharing strategies (e.g. whether they were strongly egalitarian, weakly egalitarian, generous, competitive), how these strategies developed, and how they compared to actual societal norms (measured by caregivers' responses). Preliminary results show that with increasing age, UK children were increasingly egalitarian in their judgments and strategies, while Ugandan children didn't show a strongly favoured strategy at any age. At a group level, this pattern aligned with caregiver's views, as the majority of UK caregivers favoured egalitarian strategies, while Ugandan caregivers showed a weak preference for generous strategies. Yet, on an individual level, results suggest that caregivers' choices didn't align as strongly with their own child's choices. These results suggest that children's knowledge of sharing norms is developing during middle childhood, and it may be driven more by societal norms than the specific views of children's caregivers.



## PC-09 Child-directed versus adult-directed gesture productions during scripted storytelling

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Speakers adapt their speech to match the needs and understanding of their listeners and to maximise communicative success (Bell, 1984; Ferreira, 2019; Galati & Brennan, 2010). This adaptation does not occur only in speech, but also in co-speech gestures (Holler & Stevens, 2007; Holler & Wilkin,

2009; Schubotz et al., 2019). We can most clearly exemplify this phenomenon when we compare adult-directed speech (ADS) with child-directed speech (CDS). CDS uses less complex, and shorter sentences and more variable prosodic patterns (Brand et al., 2002; Iverson et al., 1999). Similarly, adults also adapt their gestures when addressing children. They employ more iconic gestures when speaking to children and more beat gestures when addressing adults (Campisi & Özyürek, 2013; Kandemir et al., 2023; Molnar et al., 2023). To test the generalisability of those findings across different cultural contexts, we tested adults from two new linguistic backgrounds (20 French and 20 German speakers). The current study adds to previous research by exploring the effect of listener type (adult vs child) on gesture productions in a scripted storytelling task. We hypothesised that when addressing a child, participants will use more representational gestures, and their gestures will be more salient (i.e., bigger in size, longer duration, and will more often employ both hands). However, we expected adult-directed communication to have more non-representational gestures. We are using ELAN to annotate gestures (Sloetjes & Wittenburg, 2008), following an adaptation of the M3D coding scheme (Rohrer et al., 2023). Data collection is completed, but gesture annotation is still ongoing. Final analyses will be completed by December 2024. Preliminary findings from a sub-sample of the French population support our hypotheses. Adults produced more representational gestures when addressing a child, and more non-representational gestures when talking to an adult. Listener type did not modulate the overall gesture rate.

## PC-10 Focused or overstimulated? Children with greater physical and visual engagement do not learn more

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We investigate how children learn from screens that are either visually complex or simple, and whether visual and physical engagement predicts their learning. We find that the ability to visually and physically disengage both predict learning. We presented 55 3- to 6-year-old children with novel word-object pairings overlaid on a visually complex or visually simple display. Children watching the visually complex stimuli fidgeted significantly less and visually fixated more than children in the visually simple condition. However, despite higher rates of physical and visual engagement, these children did not learn more word-object pairings. Crucially, sustained visual attention predicted learning deficits in the visually complex condition. Decreased fidgeting in the complex condition may indicate overstimulation, making children appear highly focused while actually impairing their ability to disengage and ultimately disrupting learning. This finding is in line with previous work showing that children learn better from visual media from which they look away more often (Shepherd & Kidd, 2024). This work has important implications for understanding what types of media disrupt children's learning and pose a risk to healthy development. Fast-paced and fantastical television impairs executive functioning and disrupts healthy attention in young children (Anderson et al., 1977; Geist & Gibson, 2000; Essex et al., 2022; Lillard & Peterson, 2011). More generally, children's

screen use predicts developmental delays, worse academic performance, and disordered attention, among other adverse effects (Madigan et al., 2019; Lissak, 2018). Overstimulating properties of popular media content likely contribute to these adverse outcomes (Christakis, 2018). The visually salient stimuli in our complex condition depicted colorful, naturalistic scenes, which are notably less perceptually captivating than popular children's edutainment content, but still elicited potentially unhealthy over-engagement and disrupted learning. Mistaking overstimulation for enjoyment or focus risks promoting content that may actually be detrimental to learning, especially for young children.

## PC-11 Mutually exclusive future possibilities are represented in vision

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It is an open question whether infants or non-human animals have the capacity to represent possibilities: mutually exclusive, non-actual states of affairs (Carey et al., 2020). But are "possibility representations" a natural kind? We ask whether adult mid-level vision, an early developing and non human-specific capacity, is able to represent possibilities. We leverage the 'Object Specific Preview Benefit' in object tracking: people are faster to reidentify a feature on the object it was initially presented on (match) than on a different object (swap). In Experiment 1 two features (shapes) were flashed on two objects (colored discs), which then moved behind a central occluder. After a delay the occluder was removed, revealing the outcome: the discs with the shapes. In the 'known identities' condition the discs had different colors, allowing reidentification. In the 'possible identities' condition, disks shared color so at outcome there were two possible disc-feature bindings. We found that 'possible-trials behaved like match-trials and generated an OSPB compared to the swap-trials, implying that both possible ways the object-feature mappings were represented garnered a benefit. Experiment 2 extended these findings by showing that possible identities can be maintained even if there is a delay between object and feature reappearance. Experiment 3 ruled out some alternative explanations (e.g. high level reasoning) by disrupting mid-level binding. In Experiment 4 we presented 'possible' and 'known' object locations, rather than identities. Here we found that mid-level vision could only represent one, but not both possible locations. To sum, we found that mid-level vision can represent possible object identities but only one possible object location, a pattern that can help to explain the previous developmental and cross-species findings. This provides a new way of looking at possibility representations as a set of architecturally distinct but functionally related capacities.

## PC-12 The development of children's norm conformity and norm enforcement: A cross-cultural study

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Human social life is regulated by norms that determine how members of a social group ought to act. To maintain the governing role of these norms, group members must conform to them, and enforce the compliance of other group members. Engaging in norm conformity and enforcement are thus key aspects of a child's social development, but they have not been widely investigated across diverse cultural settings. To address this, we conducted a study in two very different samples: children living in (i) rural Uganda and (ii) in and around the city of York, UK. Children aged 4-11 years (N_Uganda = 172, N_UK = 161) participated in a simple card sorting task. During the task children sorted double-sided cards according to the size of the object on the card (big/small), then they were told a normative rule concerning the "right" side of the cards to play with. Norm conformity was measured by how many cards children sorted according to the normative rule. After a short break, the children witnessed an adult confederate sort the cards in a manner that violated the established normative rule. Norm enforcement was measured by coding children's behaviours and utterances in response to these norm violations. We found that norm conformity increased with age in both cultural contexts, but more steeply in the UK than Uganda. We found that whilst norm enforcement was largely absent in Uganda, it increased with age in the UK. The greater likelihood of norm enforcement in the UK could not be explained by cultural differences in task engagement, but UK children did show greater awareness that a rule violation had occurred. Taken together, these results suggest that culture might shape children's awareness of norm violations, which then influences their developing tendency to comply with and enforce social norms.

## PC-14 Do cues of agency enable great apes to understand goal-directed actions?

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Goal-based action prediction is a fundamental, early developing ability in humans, and it helps us to function in the social world. After being familiarized to the video of a hand reaching for an object, great apes and human infants looked predictively towards that object, even when its location was changed (Cannon & Woodward, 2012; Kano & Call, 2014). However, they made no predictions when the action was performed by a mechanical claw. Studies with human infants suggest that such an understanding of goal-directed actions initially developed based on their familiarity with human actions and morphology (Woodward, 2009). Other studies have proposed an innate sensitivity to behavioural cues for identifying agency and goal-directed actions, even for morphologically unfamiliar

agents (Biro & Leslie, 2007). Here, we used eye tracking to study if great apes can predict the goal of a mechanical claw when cues of agency were included. We measured their predictive looks towards the goal object of a reaching claw, with cues such as self-propelled motion and equifinal variation added to it, compared to a mechanically moving claw lacking such agency cues. While these cues proved effective in evoking agency attribution in morphologically unfamiliar agents in human infants, their impact has not been tested in great apes. If great apes looked predictively towards the same goal, this would be evidence that cues of agency are sufficient for them to attribute mental states such as intentions to an object. Finally, we also re-created the condition with a reaching human hand, to replicate the goal-based action prediction found in a previous study. Data analysis is currently underway, and the results will be presented at the conference.

## PC-15 Theory of Mind in sighted children of blind parents

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Sighted children of blind parents (SCBP) experience selectively reduced eye contact and are immersed in a specific social environment from a very young age. Research on SCBP remains scarce, and little is known about the impact of their experience on social and cognitive development, such as Theory of Mind (ToM). Limited studies suggest that, even in their first year of life, SCBP demonstrate an ability to switch between different channels of social communication depending on their interaction partners (e.g., Senju et al., 2013). This early-emerging flexibility could potentially enhance other aspects of SCBP development, including executive functions (EF), as observed in bilingual children (Kovács, 2009). Furthermore, given their unique experience, SCBP may develop an earlier understanding that individuals form beliefs based on various sources of information, including auditory as well as visual cues. A study involving preschool-aged SCBP (N=8; study ongoing) and a control group (N=25) explored these hypotheses. Participants completed the ToM Task Battery (Hutchins, Prelock, & Chace, 2008), the Card Sorting Task, and a modified version of the classic change-of-location False Belief Task. In this modified task, the additional False Belief condition was introduced, where the agent could hear, but not see, the object's movement. Preliminary results of the study will be presented and discussed.



## PC-16 Theory of mind and humor development in 16- to 46-month-olds

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The goal of this study was to investigate the relation between the development of humor and Theory of Mind (ToM), in infants. Twenty-six infants aged between 16 and 46 months (M = 27.07, SD = 8.53)

participated in this study. ToM abilities were assessed via 1) false belief understanding (Senju et al., 2011), 2) desire understanding (Repacholi & Gopnik, 1997) and 3) Intention understanding (Warneken & Tomasello, 2006). Infants' Humor understanding and production were assessed through 1) the observations of their reactions to a non-verbal humoristic video, 2) the behavioral observation of parent-infant interactions and 3) parents' responses to the Early Humor Survey questionnaire (Hoicka et al., 2021), translated in French. The results of the ToM tests showed earlier success with the intention comprehension task (92% from 16-23 months age group), while the success rate exceeded the chance level only for the 36-46 months group for False belief task (83%) and desire understanding (83%). Concerning the relation between Humor and ToM, we observed a positive and significant correlation between infants' performances measurements in ToM tasks and their Humor understanding and producing reported by parents ($r(24) = .48$ , $p < .05$). This relationship was not found when we tested the correlation between infants' ToM performances and Humor ability directly assessed with infants. Finally, the results of our linear regression models indicate no directional relation between ToM (infants' performances) and Humor (reported by parents). This result is not in line with recent literature on this point (Soy Telli & Hoicka, 2022). These results prompt us to reconsider our methodological choices and theoretical background as well as reconsidering how Humor and ToM are investigated by an experimental paradigm in the laboratory, behavioral observation in natural setting, or by the parental report.

## PC-17 Exploring predictive abilities in monolingual and bilingual infants in the presence of non-linguistic and linguistic cues

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The role of bilingualism in shaping early predictive abilities is far from understood. Bilinguals have been argued to outperform monolinguals at updating predictions due to advanced executive functions (EF). Recent evidence, however, questions the involvement of EF and attributes performance differences to monolingual and bilingual patterns of encoding initial information in prediction tasks. Specifically, bilinguals may form weaker initial associations in response to the high variability in their environment, leading to greater flexibility in updating. However, this proposal may only hold for encoding non-linguistic information since in the case of language-specific information, bilinguals may form stronger associations due to their experience of monitoring two linguistic systems. We analysed gaze data from 9-month-old Spanish-Basque infants during a non-linguistic (mon=26, bil=32) and linguistic (mon=27, bil=25) prediction task. Infants were presented with a cue: a whistle sound (non-linguistic) or a syllable string matching Spanish and Basque word orders and prosodic properties. Following the cue and anticipatory period, infants predicted the target location on one side of the screen for 9 trials (pre-switch), then on the opposite side for 9 trials (post-switch). Gaze proportions to the expected target location during the anticipatory period were analysed. Caregivers additionally completed the Early EF Questionnaire (Hendry & Holmboe, 2021). Monolingual and bilingual infants performed comparably in

both tasks. In the non-linguistic task, infants' performance was equivalent across blocks pre-switch, and it improved across blocks post-switch. In the linguistic task, both groups remained at chance by the end of the post-switch phase, suggesting that encoding language-specific information may pose a challenge for infants when updating their predictions. Infants' individual task performance and EF questionnaire scores were not correlated, suggesting that individual EF differences may not be driving the observed effects. Our findings will be discussed in light of theories on the effects of bilingualism on infant cognitive development.

## PC-18 The effects of ASD and ADHD on sustained attention and response inhibition among boys

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Background: Autism Spectrum Disorder (ASD) and Attention-deficit/Hyperactivity Disorder (ADHD) are neurodevelopmental disorders that share neurocognitive deficits although their clinical definitions are distinct. Previous studies reported deficient sustained attention (SA) and/or response inhibition (RI) among children with ASD and/or ADHD (Chien et al., 2014; Karalunas et al., 2018; Schachar et al., 2023; van Hulst et al., 2018). However, these studies yielded inconsistent results. The present study aimed to reveal the independent effects of ASD and ADHD on SA and RI among boys. Method: Eighty-nine boys aged 8-11 years participated in the study that employed a 2X2 factorial design: 13 ASD, 24 ADHD, 27 ASD+ADHD, and 25 NT participants. SA and RI were assessed by Go/No-Go tasks (Kolodny et al., 2021). Standard Deviation of RTs (STD-RT) and miss errors measured SA and false alarm (FA) errors measured RI. Results: Regarding SA, significant main effects of ASD and ADHD were obtained on STD-RT. Yet, the proportion of miss errors was significantly influenced only by ADHD. As to RI, only ADHD had a significant effect on FA errors. Conclusions: Our findings revealed that ASD and ADHD have similar effects on SA as measured by STD-RT; however, misses were influenced only by ADHD. This raises the possibility that different causes may underlie the behavioral difficulties of children with ASD and children with ADHD in staying focused for a prolonged time. RI was affected only by ADHD suggesting that assessment of RI can serve as an important component in a comprehensive evaluation of the cognitive profile of boys with neurodevelopmental disorders. Moreover, future studies are required to replicate these findings with larger samples, including girls, and to further investigate the causes of the decreased level of SA in children with ASD to better support the social, emotional, and cognitive development of children with ASD.

## PC-19 Is it ever okay to be angry? Children's judgments in China and the U.S.

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Societies shape the experience and expression of emotions through various routes – including through judging them inappropriate to feel (Nussbaum, 2000). However, little is known about the psychology of norms regulating the experience of emotions. Despite its well-known detrimental effects, theorists have long argued that anger has a crucial role in fighting injustices (Cherry & Flanagan, 2017). This duality makes anger an ideal test case for the development of intuitions about the permissibility of emotional experiences. Across two pre-registered experiments, we presented 5–12-year-old children in China and the U.S. with storybook descriptions of unequal resource distributions and asked them to evaluate the emotional response of the disadvantaged recipient. In Study 1 (N = 164), we contrasted procedurally fair and unfair resource distributions. Participants rated anger as a permissible response to unfairly but not to fairly decided distributions ($p < 0.001$). With age, children viewed anger overall as relatively more permissible in the U.S. than in China ($p < 0.01$), consistent with theorizing suggesting that anger is more congruous with the cultural values of the U.S. In Study 2 (N = 154), we contrasted an unfair teacher with an unfair peer, asking: Is it more permissible to feel anger towards an authority person or a peer? In both cultures, children judged anger as less permissible in response to an unfair teacher compared with an unfair peer ($p < 0.01$), though overall permissible in both cases. Our results reveal a developing, nuanced understanding of the appropriateness of anger. Despite anger's negative reputation, we found that children in both China and the U.S. judged the emotion as a permissible response to unfair treatment. However, children found anger impermissible in response to disadvantageous but fairly decided resource distributions. These findings highlight moral judgment as an important pathway in emotion socialization.

## PC-20 Adult gesture use in pedagogical interactions with children and adults

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Pedagogical interactions involve the use of gestures (Stam, 2013) to facilitate learning. Gesture use may vary depending on listener type (child vs. adult) and the presence of the listener (present vs. imagined). Previous studies have primarily focused on gesture use in adult-to-adult interactions (Holler & Stevens, 2007; Jacobs & Graham, 2007) or adult-to-child interactions (Gutmann & Turnure, 1979; Özçaliskan & Goldin-Meadow, 2011). However, limited research has directly compared the use of gestures between adults and children as listeners. While digital pedagogical formats - where the listener is not present - are on the rise, studies on the effect of listener presence are remarkably scarce. This study compares gesture production of adults in different pedagogical tasks directed

to either a present or an imagined listener which is either a child or adult. In the present study, 20 German adults produced three different scripted pedagogical tasks: (1) route description, (2) word explanation and (3) demonstration of the Piaget conservation task. The use of gestures during the interactions is coded by two independent raters using an established coding scheme (based on the M3D, Rohrer et al, 2023) in ELAN (Sloetjes & Wittenburg, 2008). We code the frequency, saliency and type of gestures used by the speaker. We hypothesize that speakers use most representational gestures and most salient gestures (i.e., bigger in size, longer duration, and will more often employ both hands), when speaking to present children and least amount and salience of representational gestures when addressing imagined adults. Conversely, we expect no significant differences in non-representational gestures, such as beats. We will further explore differences for different types of tasks. This research aims to contribute to the fine-grained understanding of gesture use in pedagogical interactions, with particular attention to how listener age, presence and pedagogical format shape gestural communication.

## PC-21 Cross-cultural evidence for synchronized development of false belief and aspectuality understanding

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Around the age of four, children in urban, post-industrialized societies begin to understand that others' beliefs can be both objectively false and aspectual—representing objects and situations from specific perspectives only. This development, rooted in expanding meta-representational capacities, is crucial for navigating complex social interactions. However, research linking children's understanding of false belief and aspectuality beyond these communities is lacking, raising questions about the extent to which this developmental pattern generalizes to diverse childhoods across the globe. To address this, we tested the false belief–aspectuality link in two small-scale indigenous communities in rural Namibia (Haillom, N = 65; Khwe, N = 35) and an urban German community (Leipzig, N = 66). Building upon ongoing debates in cross-cultural research, we compared children's meta-representational understanding across two task formats: a pretense-heavy format, where children passively observed scenarios with toy figurines and depicted objects, and a more realistic format, where children actively participated in transferring real objects with real people. This approach allowed us to test whether the pretense-heavy nature of standard false belief tasks contributes to the difficulties encountered by children from communities with varying emphases on pretense-based pedagogy. Task format had no effect on the performance of Leipzig or Khwe children, supporting the validity of pretense-based tasks in contexts with greater exposure to such pedagogical approaches. Among Haillom children, however, the realistic task format led to increased success likelihoods in both false belief

and aspectuality tasks compared to the pretense format (by 13% and 15%, respectively). While the developmental trajectories of children's mastery of false belief and aspectual belief tasks varied across communities, a strong positive association between these capacities was evident across the board, indicating a developmental unity of both as foundational features of human meta-representation and social cognition.

## PC-22 The syntax of shapes: Constituency tests in human adults' geometry language of thought

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Recent psychophysical evidence suggests that human adults encode geometric shapes as hierarchically structured representations, based on the minimum description length of their generative program (Sablé-Meyer et al., 2022). In this study, we take this research program one step further and test two predictions derived from the hypothesis that the mental representations of geometric shapes have constituent structure. Experiment 1 provides evidence that adults' internal representations of geometric shapes is structured. We showed participants animations depicting the generation of geometric shapes and found that participants encoded the very same shape differently depending on the structure implied by the animation. Experiment 2 provides evidence that adults' internal representations of geometric shapes is not only structured but also hierarchical. We showed participants a complex geometric shape, then asked them to detect whether a simpler geometric shape was a subfigure of the complex one. Participants were better at detecting the subfigures when the simple shape corresponded to a subtree of the complex shape. Taken together, the two experiments indicate that, just like the representation of natural-language sentences, the mental representation of geometric shapes is also tree-structured.

## PC-23 Does interpersonal synchrony affect 18-month-olds' self-other alignment?

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Early human life is shaped by social, often rhythmical, interactions. Interpersonal synchrony increases affiliation, cooperation, and coordination in adults, and leads to prosocial behavior already around 14 months of age (Cirelli et al., 2014). One possible mechanism is that synchrony affects perceived boundaries between other and self or self-other similarity, making it relevant to investigate its effects around the onset of the self-concept at 18 months. We investigated whether moving in synchrony with a stranger modulates 18-month-olds' motivation to socially align, and whether this relates to emergence of self-concept. We used a rhythmical movement task, in which toddlers (N=97) were

bounced either synchronously or asynchronously with an experimenter, followed by two measures of social alignment: a sticker task (Kampis, Grosse Wiesmann et al., 2021), and an imitation paradigm (Meltzoff, 1988). In the sticker task, toddlers saw the experimenter with a sticker on her face and were asked to choose between two stickers, one of which matched the experimenter's. In the imitation paradigm, the experimenter demonstrated operating a lamp with her head. After a short delay, toddlers were offered the lamp. We expected toddlers in the synchrony condition to be more likely to choose the same sticker as the experimenter wore, and to show more imitation, compared to the asynchrony condition. Responses were related to infants' behavior in the mirror mark test (Amsterdam, 1972), a test of self-recognition. We did not find evidence for a general effect of interpersonal synchrony. However, specifically mirror mark test passers showed a preference for the matching sticker ($BF_{10}$=8.33) and less faithful imitation ($BF_{10}$=4.27) following asynchronous bouncing. Together, these findings suggest a link between the development of a self-concept and the effects of interpersonal synchrony: once self-awareness emerges, interpersonal (a-)synchrony acts as a cue to self-other alignment.

## PC-24 Children's metacognitive understanding of experiments involving inherent confounds

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There is an ongoing debate about children's metacognitive understanding of the vary-one-thing-at-a-time strategy (VOTAT) in causal learning tasks (see Lapidow & Walker, 2021). Children have both been found to recognize the indeterminacy of confounded evidence (Köksal et al., 2021) and to draw unwarranted inferences from such evidence (Peteranderl & Edelsbrunner, 2020). As these studies were conducted in contexts without interrelated variables, it remains unclear how children approach experiments involving inherent confounds. Such inherent confounds are common in science learning. For example, in water displacement experiments, the mass of an object is inherently confounded with its size and material. As a consequence, manipulating only one variable can be misleading, whereas contrasting confounding variables by manipulating more-than-one-thing-at-a-time (contrastive MOTAT) can be most informative (Lörch et al., in press). We asked elementary school children open-ended questions about the informativeness of four types of comparisons in the domain of water displacement. In size and material comparisons, only the respective feature of an object was manipulated, leading to an inherent confound with mass. In contrastive and additive MOTAT comparisons, both size and material were manipulated so that the larger object was lighter or heavier, respectively. Based on a pretest, we conducted Bayesian modeling of children's prior beliefs (Colantonio et al., 2023). Preliminary results from 97 elementary school children (target n = 130) show that to evaluate the informativeness of an experiment, children judged whether the objects differed in the feature(s) they considered relevant and whether the experiment would produce the expected outcome. Children were generally unaware of the inherent confound in size and material comparisons, and of the indeterminacy of additive MOTAT comparisons. These findings suggest that,

in knowledge-rich contexts, children tend to adopt a positive testing strategy. In doing so, they are bound to their prior beliefs and struggle to consider alternative causal explanations.

## PC-25 Advance planning of grammatical structure during speaking develops throughout childhood: Evidence from the production of simple and complex noun phrases

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When speaking, adults routinely prepare pieces of their utterance in advance, before speech onset. This is called incremental sentence planning. While the size of increments can vary, adult speakers' initial planning scope encompasses the first noun phrase (e.g., "the cat" in "The cat is above the mouse"; phrasal planning scope, Martin et al., 2010). However, it is unknown how incremental planning processes and the scope of advance planning develops in children, that is, when and how they learn to plan sentences like adults. We present the first-ever eye-tracking study on the development of online incremental sentence planning in children. We tested whether 5- and 7-year-old German-speaking children (4;9–5;3 and 6;9–7;3 years) exhibit a phrasal planning scope like adults (n = 40). Participants described arrays of animal pictures with sentences starting with either simple or complex noun phrases (simple: "[The cat] is above the dog and the mouse", complex: "[The cat and the dog] are above the mouse"), while eye movements and speech onset latencies (RTs) were recorded to test planning scope size and the time-course of linguistic encoding. Replicating previous findings (Roeser et al., 2019), adults exhibited longer RTs and more looks toward the second noun in the complex condition before starting to speak. This indicates a phrasal planning scope, encompassing all nouns before the verb. Data collection for children is ongoing. Preliminary Bayesian RT analyses suggest a phrasal planning scope also for 7-year-olds (n = 27), indicated by longer RTs for complex vs. simple sentences but with greater differences than in adults. Inspection of fixation time-courses suggests that 7-year-olds, unlike adults, did not yet switch attention between the first and second noun strategically, based on whether they were planning simple or complex noun phrases. Incoming data from 5-year-olds will elaborate on the development of incremental planning.



## PC-27 Is infant logic domain-general? Fourteen-month-olds exclude physical possibilities that would make an agent irrational

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Logical cognition is foundational to many outstanding human feats, such as mathematics, linguistic communication, and complex problem-solving. Abstract, domain-general logical structures permeate and connect our thoughts in coherent representations and help us draw conclusions. But, what is

the origin of logic? Here, we ask whether, at 14 months, infants can connect the possible outcomes of physical random sampling with the exclusion of irrational actions to learn what an agent likes. In our task, participants watch a partially-hidden object being sampled from a container of balls and cars (in equal numbers; hence, the object must be a ball OR a car). Next, an agent is faced with a choice between a distant partially-hidden object or a closer, fully visible one (e.g., a ball). The agent eventually chose the distant one. Presented one time with this sequence, adults immediately infer that the agent must want an object of the other possible kind (e.g., a car). In a pre-registered habituation experiment, we tested whether 14-month-olds (N=18, ongoing) can do the same. Infants were habituated to the same movies shown to adults. The identity of the partially-hidden object was never revealed, but it could be inferred logically by representing the possible sampling outcomes and excluding the choice that would make the agent irrational. At the test, infants are shown choices between the partially-hidden object – now fully visible – and a novel object. Preliminary analyses suggest infants expect the agent to choose the first object, a result consistent with rapid learning via domain-general disjunctive inference. An ongoing follow-up experiment controls for a potential novelty preference. Our findings start revealing the abstractness of infants' logical capacities while addressing deflationary accounts (Jasbi et al., 2019; Feiman et al., 2022), pointing to the existence of a domain-general core logic of thought from infancy.

## PC-28 Is infant-directed speech attractive because it is unpredictable? An EEG study

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Recent large-scale investigations confirmed that infant-directed speech (IDS) with specific features (e.g., more variable pitch, exaggerated vowels, lower speech rate) attracts the attention of infants more than adult-directed speech (ADS) and that this finding held across many different cultures (Many Babies Consortium, 2020; Zettersten et al., 2024). However, it is unclear why. The predictive processing framework suggests that it is advantageous for our brain, which adapts by predicting upcoming events, to pay more attention to and assimilate unpredictable/surprising information, to improve future predictions (Friston 2005, 2010). Following this reasoning and since the pitch contours are less predictable in IDS than in ADS (Räsänen et al., 2018), we asked whether the portions of IDS that are most unpredictable engage infants' attention the strongest. We used computational modeling and infant EEG data to determine whether midfrontal theta power, a neural signature associated with attention, is positively correlated with how unpredictable the pitch contour of IDS is. Specifically, we extracted the unpredictability of pitch contours in stories read to Dutch-learning 7.5-month-old infants using infant-directed speech (IDS) while their brain activity was measured using 32-channel

EEG. We also investigated whether the strength of the relation between pitch unpredictability and theta power is associated with two language learning outcomes (word segmentation and word comprehension). Using a pre-registered Bayesian Generalized Mixed Effects analysis under several data pre-processing scenarios, we did not find evidence for an association between theta power and pitch unpredictability. Moreover, we did not find evidence that the relation between theta power and pitch unpredictability at 7.5 months was associated with word segmentation at 9 months or word comprehension at 18 months. We discuss the relevance of these findings for IDS research and suggest modifications to the experimental task to gather clearer evidence about the relation between pitch unpredictability in IDS and theta power.

## PC-29 Music and social behaviour: Faster rhythms lead to more prosociality and social interaction in children aged 3 to 6

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Music exists in humans for at least 40,000 years and in all societies. Its perception, appreciation and production are based on some cognitive abilities commonly referred to as “musicality.” Some authors have suggested that musicality may have an evolutionary origin. Specifically, it may have evolved because music promotes group cohesion. This hypothesis is supported by studies showing that joint music-making promotes empathy, cooperation and helping in children. In previous studies presented at the BCCCD in 2020 and 2024, we also have demonstrated that joint music listening sometime promote social interaction and cooperation, with different results depending on the stimuli used. Indeed, consonant classical music promoted social interaction more than dissonant music, and a electronical instrumental piece composed for our project (Meier’s track) promoted cooperation and social interaction more than Mozart’s music. Moreover, listening together promoted social interaction and cooperation more than listening separately. Together, these results suggest that consonance is involved in the relation between music and social behaviour, and perhaps rhythm. Indeed, our results are in line with the idea that listening music together (in particular music with high rhythmicity) may promote interpersonal synchrony and lead in turn to more social interaction and cooperation. Here, to test further this hypothesis, we performed an experience with 200 children from age 3 to 6. They listened in pair one of three stimuli : Meier’s track (120 bpm), the same track with slower tempo (90 bpm), and with higher tempo (150 bpm). Then, they were tested in three cooperation tasks. As expected, 120 and 150 bpm tempi promoted more social interaction and cooperation than the slower tempo. The role of interpersonal synchronization will be further explored by examining the spontaneous movements of individuals during listening and their relation to behaviors in subsequent prosocial tasks.

## PC-30 Hanna likes everything that makes loud! Investigating 2-year-olds' desire understanding for action effects

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Most of the current research on children's desire understanding diverging attitudes towards objects. However, as children's tool use abilities increase through their second year of life, action effects as goals get increasingly important. In the context of tool use, an understanding of diverse desires for action effects helps predict not only which object a person might approach but also how they might manipulate a given object to achieve a desired effect. This study examined whether 2-year-olds (N=46) systematically use their knowledge regarding the penchant shown by two others for different effects (i.e., sounds or lights) in later interactions. Children were introduced to two hand puppets, each of which presented their favorite toys producing either a sound or lighting up. Then, children learned how to manipulate two effect boxes with a stick to elicit either a sound- or a light-effect: One required inserting the stick in a cut-out in the front of the box ("slide") and the other required inserting the stick in a whole at the top of the box ("press"). In two test trials, the puppets reappeared asking the child to do something that "makes me happy". An analysis of children's first action revealed that success, i.e., eliciting the required effect, mainly depended on the required movement (press: 62% vs. slide: 5%). Success increased when considering all actions during a test trial (press: 80% vs. slide: 26%). Further, the effect of the required movement was less pronounced when looking at children's first gaze towards the correct (congruent) or incorrect (incongruent) box (press: 60% congruent vs. slide: 41% congruent). While our results do not allow for strong claims about 2-year-olds desire understanding for action effects due to children's overshadowing tendency to perform the press action, our results yield interesting insights into early multifunctional tool use in a social context.

## PC-31 Is implicit mentalising "social"? Investigating the domain-specificity and developmental trajectory of implicit mentalising

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Implicit mentalising involves the automatic awareness of others' perspectives. While crucial to social functioning, its domain-specificity and developmental trajectory are debated. The Joint Simon task is thought to demonstrate implicit mentalising: Pairs sitting side-by-side perform a go/no-go task on the same screen, each responding to different coloured stimuli. Despite stimuli location being task-irrelevant, Joint participants respond faster to stimuli on their (vs. their partner's) side; this is the Joint Simon Effect (JSE), which is stronger in a Joint versus Individual task condition. The JSE may stem from spontaneous co-representation of a partner's frame-of-reference, creating a spatial overlap between stimulus-response location in the Joint (but not Individual) task. However, whether the JSE is driven by domain-specific social processes or domain-general processes remains debated. We

investigated the potential contents of co-representation during task-sharing in adults (N=52)—typical geometric stimuli were replaced with two coloured sets of animal silhouettes, each assigned to either the participant or their partner. Critically, a surprise image recognition task followed to identify partner-driven effects in incidental memory exclusive to the Joint condition. Participants in the Joint task did not recognize their partner's stimuli more accurately than participants in the Individual task, implying that participants were no more likely to encode content from their partner's perspective during the Joint task. However, Bayesian statistics ($BF_{01}$=31.25) indicated a robust absence of the JSE, limiting interpretations of incidental memory findings, and raising questions regarding JSE's replicability. To follow-up, we are investigating whether this pattern holds in children between 3.5- to 5-years-old (a critical period of explicit Theory of Mind development), after accounting for theoretically influential individual differences such as executive function, receptive vocabulary, and explicit ToM abilities. We will present the latest findings across adults and children, discussing the developmental trajectory of implicit mentalising, and the methodologies used to probe this question.

## PC-32 Building blocks of episodic memory: Relational binding at 12 months

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Remembering episodes from one's life requires binding specific information about things, people, and scenes into unique events, sometimes without causal or semantic links. From their second year, toddlers encode increasingly specific information about events, from learning general knowledge to remembering from where or with whom they learned something, until forming flexible and rich episodic memories from around three years of age. In a longitudinal project we investigate children's emerging episodic memory capacities between 12 and 36 months (planned N = 125). We hypothesize that this development benefits from infants' social experiences and interactions with caregivers, where their own view often contrasts with that of others and binding specific perspectives to people –that is tracking their source of knowledge– becomes necessary. At 12 months, this project first measures early memory-binding with eye-tracking. In a set of tasks infants were shown 1) a face matching (vs. non-matching) its previous scene context (face-scene binding), 2) a color matching (vs. non-matching) its previous spatial location (feature-location binding), and 3) an item matching (vs. non-matching) its previous association with another item (item-item binding). Replicating previous studies, pilot data (N = 25) found no scene-face binding (p = .389), but significant color location binding (p = .006), and item-item binding (p = .040) at a younger age than previously shown. Tasks did not correlate, except for a negative correlation between feature-location and face-scene binding (p = .020). Preliminary analyses on our cohort (n=55) are in line with pilot results, data collection finishes November 2024. These results provide tentative evidence for distinctive binding mechanisms after one year, for remembering first-time, arbitrary associations of information. Anticipating person- or object-specific binding at two years, these mechanisms may set the ground for the emergence of adult-like episodic memory capacities.

## PC-34 The associations between digital devices and children's executive function, socio-cognitive development, and parenting style

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The rapid evolution of devices (Carr & Dempster, 2021) creates a constantly changing environment. Due to the plasticity of the nervous system, the environment is of great importance early in life, both for the development of cognitive skills and behaviour (Pechtel & Pizzagalli, 2011). In this sensitive period the interrelated development of theory of mind and executive function begins to emerge (Perner & Lang, 1999) which, if impaired, can be a risk factor for behavioural problems in children (Holl és mtsai., 2021). As part of children's developmental environment, it is also important to explore the influence of the parents' parenting style as it affects both device use and skills (LeVine 2006). In our research, we hypothesized that the more time a child spends using digital devices, the lower the level of executive function and socio-cognitive ability, and in addition the more negative the parenting style and lower the levels of parent-child joint activity. Furthermore, we hypothesized that regular digital device use contributes to slower development of the assessed skills in the longer term, as well as to a decrease in the quantity and quality of parent-child interaction. To investigate the hypothesized associations, we used a longitudinal study method to measure the abilities of healthy 4-5 year old children at three different time points during a year, in an online video call. We used behavioural tests to assess executive functions and socio-cognitive skills and parent questionnaire to measure children's use of digital devices throughout the study. We also assessed parenting style and parent-child interaction using questionnaire and observation methods. Preliminary results are presented and discussed. We expect that the results will help to understand the impact of digital devices.

## PC-35 Culture-specific prompts shape early social responsiveness

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Recently, prosocial development in early childhood has been studied through the cross-cultural lens (Brownell, 2016; Köster et al., 2015). A critical precursor in prosocial development is to respond to others prompts, which is socialised and develops very differently in different cultures (Giner Torréns & Kärtner, 2017; Köster et al., 2016). Commonly, parents in relational cultural contexts request their children assertively, while parents in autonomous cultural contexts request their children's engagement deliberately, both shaping early prosocial behaviour in culture-specific ways (Köster et al., 2022). Yet, former studies have tested dyadic interactions and are correlational. Thus, the causal role of culture-specific parental requests in the ontogeny of social responsiveness is not understood. The present study systematically tested the effect of culture specific prompts on the social responsiveness of 105 children aged between 24 to 30 months in Ibadan, Nigeria and Regensburg, Germany. We assessed

maternal requesting behavior using a compliance with request task (Köster et al., 2016). To test the implications of different requesting styles for social responsiveness experimentally, we designed a task where the experimenter prompted the child to hand over three objects of everyday life, one time using an assertive prompt ("Give [the object] to me, now!), and the other time using a deliberate prompt ("Could you give [the object] to me, please?"). In line with our hypothesis, social responsiveness was shaped by culture. German mothers showed deliberate scaffolding using questions, explanations and pleading. At the same time their children showed higher rates of social responsiveness towards deliberate compared to assertive prompts by the experimenter. Conversely, Nigerian mother showed more assertive prompts and their children also responded more reliably towards assertive requests by an experimenter. These findings indicate a causal role of the culture-specific interaction context in which social responsiveness emerges for the cognition and motives underlying social responsiveness.

## PC-36 Can infants represent multiple possibilities?

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Representing possible states of the world -- that things could be different from what they are -- is fundamental to be able to make hypotheses and gain knowledge. Whether this ability is present in humans before they understand language is controversial. Some findings, and in particular the fact that three-year-olds and primates fail to use both hands to catch with certainty a ball falling into an inverted-Tube (Redshaw and Suddendorf, 2016), cast doubt on their abilities to represent possibilities, and even less so infants (Feiman et al 2022; Leahy and Carey 2020). Other findings suggest that even preverbal infants might conceive disjunctive or possible states (Cesana-arlotti et al. 2020; Teglas and Bonatti, 2016). Here, we created a simplified version of the tube task, which we tested with adults and infants in an oculomotor paradigm. Participants saw a ball falling into a tube with either two or three branches, one of which was always shorter than the others. They could trigger a visual reward if they could anticipate where the ball would exit. Crucially, for some consecutive trials the ball exited from the short branch, and after participants learned to anticipate the ball exit, it exited from the long branch. Our main measure was the ability to recover from previous anticipation, shifting eyes towards the alternative exit(s) and anticipating the novel exit. Adults (N=30, mean age=25.33) easily reoriented towards to the long exits, as expected, beginning to shift their gazes towards them as soon as they did not see the exit from the short branch. Infants (N=36,mean age= 16m 16d) did not anticipate online with the set criteria, but they did reorient their gaze to the long exit, suggesting an ability to understand alternatives and plan accordingly. Further analyses need to confirm this conclusion.

## PC-37 Neurophysiological and oculomotor markers of human reasoning

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Recently, there has been a surge in research about the representations underlying logical thought and its development. Some paradigms suggest early emergence of logical representations, such as disjunctions of possibilities (Cesana-Arlotti et al., 2018, 2022; Martín-Salguero et al., 2023); However also non-logical processes, such as building single simulations of reality, may be a plausible explanation of infants' and toddlers' behaviors in a series of tasks (B. Leahy et al., 2022; B. P. Leahy & Carey, 2020). With the exception of Martín-Salguero et al., (2023), no attempt has been made to systematically characterize the neural and oculomotor signatures of the representations involved in these tasks. Here we begin to do that in adult participants, with the aim of extending the investigation to preverbal infants. Our work will help us adjudicate between competing theories of the development of logical reasoning. Building on previous studies (Cesana-Arlotti et al. 2018; Martin-Salguero et al., 2023), we created nonverbal scenes that can be easily adapted for infant participants. Videos feature an object inside a cup whose identity can be either known or unknown. When the object's identity is unknown, participants may be given disambiguating evidence through which they can infer the contents of the cup. In Experiment 1, we induced a strategy akin to single event simulation, asking participants to explicitly bet on the identity of the unknown object. In Experiment 2, we induced participants to represent the scene "logically", thinking of the object as "unknown". We co-register EEG and oculomotor data to characterize the signatures of the mental representations induced. Eye tracking results obtained thus far show discernible patterns for the different conditions at the topical moments of interest. Electrophysiological data analysis is ongoing. Overall, these studies could help us unveil the nature of mental representations at the core of human reasoning and their development.

## PC-38 Is there a shape bias when naming scenes?

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Young children demonstrate reliable intuitions when generalizing novel nouns labeling objects, including extending nouns to objects of the same shape (e.g., Landau et al, 1988). Do young children show a similar shape bias when extending nouns labeling other spatial entities? In four preregistered experiments, we explore children's word-learning intuitions when they hear novel nouns applied to navigable places. In Experiment 1, 3-year-olds (N=24), 6-year-olds (N=24), and adults (N=24) saw rendered indoor scenes of a room of a particular shape and color (e.g., blue hexagonal room) labeled by a novel noun (e.g., "Here is a blicket!") and were asked to extend the noun to a room of either the same shape (e.g., green hexagonal room) or color (e.g., blue triangular room). Six-year-olds and adults (but not 3-year-olds) showed a shape bias, choosing rooms of the same shape. Experiment 2 tested whether these results were specific to places by presenting different groups of participants

with containers matched in shape and color to the rooms in Experiment 1. At all three age groups (N=72), participants extended nouns to objects of the same shape, suggesting that 3-year-olds show a shape bias for objects prior to showing a shape bias for places. Since texture may be a stronger diagnostic feature of places than color (Oliva & Torralba, 2006), Experiments 3 and 4 (completed by November 2024) focus on shape versus texture. Pilot data suggest similar results for objects as in Experiment 2, with 6-year-olds and adults (but not 3-year-olds) showing a shape bias. Critically, however, pilot data also suggest different results for places, with 6-year-olds extending nouns based on texture and adults showing no preference. The present work expands the spatial domains of previously observed word-learning biases and sheds new light on children's intuitions about the spatial world and the language used to describe it.

## PC-39 Frontal asymmetry response predicts preference for prosocial behavior in 12-month-old infants

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Existing studies paint a mixed picture about the developmental course and neural underpinnings of infants' evaluation of prosocial behaviors (Jin et al, 2018; Biro et al, 2015, 2021; Cowell and Decety, 2015). In the current study, we investigated if infants' preference for comforting over ignoring behavior could be predicted by infants' frontal asymmetry (FA) responses while observing such behaviors. Greater relative right frontal activity is associated with regulating of "withdrawal emotions" , while greater left frontal activity is associated with "approach emotions". We hypothesized that those infants who show more approach-like tendencies in response to observing comforting compared to ignoring behavior will be more likely to choose the comforting character. During the EEG measurement, 88 infants (49 boys) watched two types of animations involving two characters, a larger and a smaller one who moved together then separated from each other. The separation was accompanied by a crying sound, and the larger character either returned ("Comforting") or went further away ("Ignoring"). The animations were shown in 4 blocks, each containing 3 animations of the same outcome. FA (6-9 Hz) was calculated between 11 pairs of frontal electrodes. Infants' preference was assessed by letting them choose between two characters after watching animations of comforting and ignoring behavior of these characters 4 times each. Touching, grabbing or pointing at one of the characters were counted as a choice. The order of the animations, color and side placement of the characters were counterbalanced. We found that the difference score between FA for the comforting and ignoring animations predicted infants' preference (B=-13.03, S.E.=6.15, Wald=4.48, p=.03). A relative more approach-like FA for comforting behavior predicted choosing the Comforting character. Our findings suggest that individual differences in the strength of motivational tendencies for prosocial vs. antisocial behaviors predict the emergence of overt prosocial preferences in infants.

## PC-41 Socioeconomic status and maternal behaviors encouraging infant exploration

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Early exploratory behaviors are crucial for infants' motor, cognitive, and social development (Babik et al., 2022). While maternal responsiveness(Landry & Smith, 2006) and stimulating behaviors (Belsky et al., 1980) have been linked to infant exploration, limited research has examined specific maternal behaviors that promote it. This study aims to classify and examine maternal behaviors that encourage exploration. Given the relationship between socioeconomic status (SES) and maternal behaviors (e.g., sensitivity) (Hoff & Laursen, 2019), we hypothesized that SES would be positively related to mothers' encouragement of infant exploration. Participants included 110 mother-infant dyads. Infants' age ranged between 9.7 and 15.9 months (M(SD)=11.9(1.4); 43% female). Maternal encouragement of exploration was categorized into five behaviors: offering novel objects (e.g., giving an object when the infant is disengaged), information giving (e.g.,describing how to play with an object), positive reacting to infant exploration (e.g., "Well done!"), creating novel scenarios (e.g., using a cup as a ball), and asking stimulating questions (e.g.,asking the function of an object). These behaviors were coded from 10-minute mother-infant free-play videos using a 5-point scale, except for offering novel objects, which was coded as frequency. The dimensions were standardized (z-scores) and averaged to create a composite maternal encouragement score. SES was measured using maternal education, employment status, and household income. As expected, SES was positively associated with mothers' encouraging behaviors (r=.36, p <.001), while infant age was not. Higher-SES mothers engaged more frequently in information giving (M(SD)=2.33 (.74)) (r =.38, p<.001), offering novel objects (M(SD)=5.86 (5.28)) (r =.21, p=.037), and reacting to exploration (M(SD)=1.50(.60)) (r=.20, p=.045). However, creating novel scenarios (M(SD)=1.44 (.47)) and asking stimulating questions (M(SD)= 1.02(.08)) were not associated with SES. In conclusion, this study developed a coding system for maternal behaviors that encourage exploration and highlighted the link between SES and the promotion of exploratory behaviors in infants.



## PC-42 Developmental change in the value systems for reward and information: An EEG-MVPA cross-sectional study

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Information-seeking shapes attention allocation and exploration from early infancy (Poli et al., 2020). Seeking information and reward rely on and activate similar underlying neural architecture (Kobayashi & Hsu, 2019), yet a degree of independence from each other is reported in human adults (Cogliati-

Dezza et al., 2022). It remains unclear whether information and reward are processed as overlapping or distinct signals from infancy. We investigate whether the neural systems encoding reward and information start as unitary and specialize throughout development or begin as independent systems that later converge. Forty adults and 40 7-month-old infants will participate in an EEG-eye-tracking associative learning task. Participants are presented with 240 (adults) or 40 (infants) cue-target trials where cues can be informative or non-informative about a subsequent target location, and targets can be rewarding (adults: face associated with monetary reward, infants: mother's face) or non-rewarding. This 2x2 combination of cue-targets generates four trial types, and the cues' shape and color indicate the trial type. Examining the neural response to cues using multivariate pattern analysis (MVPA) allows decoding patterns of neural activity related to reward and information. Representational similarity analysis (RSA) will compare the similarity between the neural activity patterns across value systems (reward vs information) and age groups (infants vs adults). A strong overlap between the two systems in infants compared to adults would suggest an initial single system that increasingly specializes during development. Conversely, greater independence between the systems in infancy compared to adulthood would suggest independent systems that increasingly overlap across development. Preliminary adult results (N = 11) show a successful decoding of information and reward, which show partly overlapping neural activity patterns (frontal brain regions) but distinct neural activity (central brain regions) observable only for reward processing. Adult and infant data is currently being collected and will be presented at the conference.

## PC-43 How do children judge the fairness of compensation in division of labor?

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Division of labor is an indispensable part of our lives, as it allows cooperation partners to focus on specific aspects of a task to reach desired outcomes efficiently (Smith, 1994). However, it might also make it difficult to agree on a fair allocation of rewards, as it requires cooperation partners to work on qualitatively different tasks. When certain groups are linked to more prestigious or better compensated tasks, it can also reinforce inequality and stereotypes (O'Connor, 2019). Here, we present preliminary results from a project exploring how US-based 6-12-year-old children and adults judge the fairness of compensation in such scenarios. We presented participants with unequally compensated cooperative endeavors involving two required activities (e.g. feeding some pets) that were performed via parallel cooperation (e.g. each cooperation partner feeding half of the dogs and half of the cats) or division of labor (e.g one feeding dogs and the other feeding cats). We show that children (target N = 105, current N = 71) and adults (N = 108) believed unequal compensation was more acceptable for division of labor, even though in both cases they believed the partners worked equally hard. A preliminary analysis suggests that participants justified unequal compensation in division of labor by assuming that whichever job was higher-paid was more difficult. Children, in general, believed that unequal compensation was more acceptable compared to adults. These results help us understand

how children and adults perceive unequal compensation in various cooperative arrangements. They suggest that, from a young age, people can justify unequal pay by assuming higher-paying jobs are more difficult and therefore more deserving of greater compensation. This tendency may contribute to justifying lower pay for certain jobs (e.g., believing that traditionally female-dominated roles, such as childcare, are "easy" jobs because of their lower or nonexistent pay).

## PC-44 The impact of picture quantity on learning with multimedia presentations

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In classroom teaching, pictures and text can help students process and remember what they are learning more efficiently. When using digital presentations, pictures often only depict a part of the spoken text on each slide. Pictures enhance students' ability to remember information presented visually and audibly (text-and-picture information), but it is unclear how well students recall information that was only verbally presented (text-only information). Pictures may have a perceptual advantage; therefore, they may be beneficial for text-and-picture information, but they could also serve as distractions when it comes to text-only information. Furthermore, this distracting effect may become more pronounced as the number of pictures increases. In our study, we tested whether the efficiency of learning text-only information changes as the number of simultaneously presented pictures increases. We recruited a total of 260 high school students (M=16 years, SD=0.874). Students watched a 12-slide multimedia presentation during a class. The number of pictures that could appear on a slide varied randomly from 0 to 2. Following the presentation participants answered 24 open-ended questions assessing how well they remembered to the content of the presentation. Some of the questions asked for text-and-picture information, while others asked for text-only information. In general, students recalled more text-and-picture information. The recall performance of the students regarding text-only information was similar when the slides contained zero or one multimedia element, whereas their performance on the retention test decreased significantly when the slides contained two pictures. Our results indicate that pictures in digital presentations enhance the learning of text-and-picture information. When used appropriately, pictures effectively highlight and teach key terms and concepts. However, for maximum efficiency, it is not advisable to include more than one picture per slide, as even two pictures seem to reduce the learning efficiency of text-only information.

## PC-45 The lost-owl task: A novel method for measuring number line estimation

Defne Koçhan[1], Şeref Can Esmer[2], Tilbe Göksun[1]

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Mental number line is the spatial representation of numbers on a horizontal line where numbers increase from left to right. This representation can bridge children's earlier spatial and later math skills (Tam et al., 2019), but empirical findings did not always support this argument (Gunderson et al, 2021). One reason is that the widely-used Number Line Estimation task (i.e., NLE, Booth & Siegler, 2008) is a symbolic one, complicating the measurement of mental number line in earlier ages. Thus, we designed a novel task (Lost-Owl-Task), asking children to map discrete quantities linearly using different configurations of multiple cubes. We expected better performance in this Lost-Owl-Task than the former measures of NLE, a decrease in performances with increasing target quantity, and a positive correlation between NLE performances and numeracy skills. We tested 48 Turkish-speaking children (Mage=62.69 months, SD=8.46, Range=44-80). We collected data on children's NLE skills using novel Lost-Owl-Task, and former symbolic and non-symbolic estimation tasks (Liang et al., 2021), and numeracy skills using children's highest count (i.e. the highest number children counted until 100 (Cheung et al., 2017). Our results showed that children performed comparable in Number-to-Position (i.e., NP, M=2.51) and Lost-Owl-Task (M=2.65) estimation tasks (t(47)=.29, p=.044), and better than the Non-Symbolic (i.e., NS) task (ts<-2.67 , ps< .001 respectively). While NP and NS were correlated (r(46)=.58, p<.001), Lost-Owl-Task showed weak and no correlation with NP and NS (r(46)= .29, p= .044 ; r(46)= .27 p = .067, respectively). Furthermore, linear mixed effects analyses revealed that the number of cubes in a trial, and children's highest count (ps<.001) predicted only Lost-Owl-Task performance. However, only age predicted the performance in former estimation tasks (p=0.017). Overall, using discrete quantities instead of symbolic numbers enabled capturing NLE skills during preschool ages and revealed more reliable links with children's numeracy skills.

## PC-46 Children's evaluations of the expertise and trustworthiness of online sources

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Children are skilled at evaluating an informant: prior research has specifically shown that children use a variety of cues to assess whether an informant is likely to be trustworthy, or an expert when appropriate (e.g., Chalik et al., 2022; Corriveau & Sobel, 2010). However, appreciably less research has examined whether children leverage these skills in evaluating online sources. The current study investigated if children can evaluate online sources across two dimensions: trustworthiness and expertise. Children (N=76 8- to 10-year-olds) saw two real Instagram posts on the risks or safety of real-world topics (vaccines, vaping, fireworks, and oil drilling). On trustworthiness trials, the posts varied in their trustworthiness but were equal in expertise. On expertise trials, the posts varied

in their expertise but were equal in trustworthiness. On both trial types, children were asked (1) which post is more of an expert on that topic, and (2) which post they trust more about it. Children selected the post with greater expertise at levels above chance on expertise trials, regardless of the question, and the post with greater trustworthiness on the trustworthiness trials (all ps<.01). On trustworthiness trials, when asked which is an expert, children chose the more trustworthy post at levels above chance only half the time (Oil Drilling, p<0.05; Firework Safety, p=0.051). This suggests that children can distinguish which posts are more trustworthy or more of an expert on trustworthiness and expertise trials, respectively. When evaluating posts along a second dimension on which both posts were equal (e.g., when asked about which post to trust on an expertise trial), children often defaulted to the alternative dimension on which one source was clearly preferable than the other (e.g., choosing the more expert post), rather than being at chance.

## PC-47 Emergence of emotional representation in 15- to 18-month-olds: Responses to object-directed emotional expressions

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In our research, we aimed to explore the emotion representation, i.e., the ability to feel an emotion, when there is no trigger for it, that emerges from an ostensive emotional expression directed toward an object and, which establishes a system of expectations regarding the characteristics of preferences for that object. This is consistent with the previous empirical findings: on the phenomenon of social referencing in 6-14-month-olds (Klinnert,1984; Moses, Baldwin, Rosicky, Tidball, 2001; Mumme, Fernald, 2003), on across-person generalization effect of referential emotion displays when ostensively cued in 14-month-olds (Egyed, Kiraly, Gergely, 2013). The research question was whether there would be a difference in the infant's looking time when the subsequent object choice is either expected (congruent, meaning the action has the same valence) or unexpected (incongruent, meaning the action has a different valence) based on the value or valence (positive vs. negative) of the prior emotional expression. The participants (N=37) saw different emotional attitudes of an agent to different, apparently neutral objects (a "pleasant" reaction to one and an "unpleasant" reaction to the other) in the familiarization phase. In test phase the agent selected one of the objects, either in accordance with the emotional attitude (selects the one to which the "pleasant" reaction was expressed; consistent condition), or inconsistent with the emotional attitude. We compared looking time in the test phase across conditions and found statistically significant differences (Wilcoxon test, [Z =483, p = 0,047, $\eta^2$ =5,24]). We have an ongoing study 2 with more complex conditions: emotions are equally positive but different (interest and liking), they are not/are matched by intention (explore or pet). We also would like to consider possibly identifying two response patterns (longer looking in the inconsistent condition and longer looking in the consistent condition) that are likely to correlate with attachment security and/or temperament.

## PC-48 Can infants make inferences on categories? Probing the mechanisms of early logical reasoning: A design proposal and adult validation

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Humans can construct multiple scenarios to formulate and test hypotheses to understand the world around them. Yet, the origin of this fundamental ability is still unknown. One line of research suggests that elementary, but adult-like, forms of such reasoning already exist in infants, who can identify unknown objects by eliminating possibilities (it can be A or B; it is not A; it must be B; Cesana-Arlotti et al. 2018; 2023; Ekramnia et al. 2021). Alternative interpretations suggest that they need not reason in such situations, but exploit mechanisms tracking objects, their locations and identities, which are sophisticated but perceptual in nature. To compare these accounts, here we present a novel task. To disambiguate an agents' preference for two kind on animals, participants must make an inference on categories. To test that the task goes beyond individual object tracking, participants must determine the agents' preference for novel objects of one of the categories, hence making spatiotemporal object indexes useless. Here we present a first validations of this design with adults. Preliminary eye tracking results show a pupil dilation effect when disjunctive reasoning is needed to disambiguate the category of the target objects. The validation with adults suggests that the paradigm may be fruitfully applied to infants, helping to determine if, when direct experience alone cannot suffice to resolve an ambiguous situation, infant resort to perceptual object tracking or logical reasoning.

## PC-49 Measuring long-term visual recognition memory in the infant brain with frequency-tagging EEG

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The ability to memorize and recognize visual inputs is a fundamental function that emerges early in development (Pascalis & de Haan, 2003). A variety of methods have been designed to assess visual recognition memory in infants (Rose et al., 2004). However, it remains difficult to define sensitive and objective markers of long-term (i.e., for days) recognition memory that can be used at any age. Here, we report a novel approach in 4- to 6-month-old infants using frequency-tagging electroencephalography (EEG). Twenty-four infants were tested twice (minimum 1-week interval between appointments) while exposed to visual streams of 3 stimuli / second to tag a general response at 3 Hz and harmonics (i.e., integer multiples) in the EEG spectrum. Stimuli were 36 natural images divided in 3 sets of 12 categories with different exemplars across sets. For each infant, one set was learned each night between the two appointments using a book that parents had to show and read. During the experiment, this set was presented as every 3rd stimulus within the stimulation to tag a visual recognition response at 1 Hz and harmonics in the EEG spectrum. Results revealed the general response over the middle occipital cortex at both appointments, indicating that infants paid similar

attention to the stimulation before and after learning. In contrast, there was no significant visual recognition response at the first appointment, whereas a significant response to the learned images was identified at the second appointment over occipito-temporal brain regions. This demonstrates that the images infants were exposed to through book reading, which had no special status before learning, are then well recognized after learning. Hence, we document a powerful EEG approach to measure long-term visual recognition memory in infancy and beyond, such that characterizing early memory functioning and tracking memory development across the lifespan, are substantially facilitated.

## PC-50 Metacognition and modal reasoning: How does 3-year-old children's ability to represent uncertainty relate to their ability to make rational choices in light of this uncertainty?

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Metacognition and modal cognition are fundamental for children's higher cognition, but research suggests that explicit mastery of these abilities occurs only around ages 4-6. Younger children often fail to acknowledge their uncertainty: For instance, in partial ignorance tasks, children up to 6 years incorrectly claim to know which of several items is hidden (e.g., Rohwer et al., 2012). Similarly, in tasks requiring modal reasoning - such as choosing between one certain and two uncertain options - only children older than 4 demonstrate competence (e.g., 3-cups-task; Mody & Carey, 2016; Leahy et al., 2022). While previous research focused on these abilities in individual learning and decision-making, recent theories highlight their social origins and functions (e.g., Shea et al., 2014). Empirical evidence supports this, showing even 3-year-olds explicitly acknowledged their ignorance in socio-communicative paradigm of the partial ignorance task (Meyer et al., 2024a). However, embedding the 3-cups-task in comparable social contexts did not enhance modal reasoning, as 3-year-olds made irrational choices in both individual and social conditions (Meyer et al., 2024b). This raises the question why social contexts enhance metacognitive but not modal reasoning performance. The present study investigates whether this arises from differences in the tasks' measures: Partial ignorance tasks only require representing uncertainty, whereas 3-cups-tasks require integrating uncertainty and certainty to make a rational choice. We compared 3-year-olds' performance across both tasks and measures. Children were randomly assigned to either a social partial ignorance or a social 3-cups-task. Both tasks included metacognitive test questions (less demanding local uncertainty measure) and choices between certain/uncertain options (more demanding integrated choice measure). Preliminary data (n = 81 of N = 136) suggest that different measures alone cannot fully explain children's diverging performances across metacognitive and modal reasoning tasks. This study contributes to understanding the relationship between these cognitive abilities and their socio-communicative development.

## PC-51 Influence of zygosity, sex, and age on parent responses to the strengths and difficulties Questionnaire (SDQ-4-17): A twin study

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Twinhood presents distinct developmental challenges and characteristics as twins share their environment and resources throughout their lives. The psychological and behavioral traits of monozygotic (MZ; 100% shared genes) and dizygotic (DZ; 50% shared genes) twins may be influenced by both genetic similarity and developmental factors. This study explores the impact of zygosity, sex, and age on Strengths and Difficulties Questionnaire (SDQ 4-17) scores in twin children and adolescents. The SDQ, a widely used tool for assessing emotional and behavioral issues, is divided into two domains: Total Difficulties (which includes emotional symptoms, conduct problems, hyperactivity/inattention, and peer relationship problems) and Prosocial Behavior. Caregivers of twins aged 5 to 17 from a cohort at the School of Dentistry and the Institute of Psychology at the University of São Paulo completed the SDQ (4-17) individually. The sample comprised 162 Brazilian twins (81 pairs): 80 MZ twins, 38 same-sex DZ (DZss) twins, and 44 opposite-sex DZ (DZos) twins, totaling 93 girls and 69 boys, with an average age of 10 years. Linear mixed-effects models, with twin identity as a random factor, were analyzed using permutation tests in R. The analysis revealed significant interactions between sex and age for Overall Difficulties, indicating higher difficulties for younger or boy twins ($p=0.04$) and a notable effect of zygosity, with DZ twins scoring higher ($p=0.04$). For Prosocial Behavior, there was a significant interaction between zygosity and sex, showing higher scores for DZ twins generally ($p=0.002$) and MZ boys compared to MZ girls ($p=0.001$). These findings underscore the complex interplay between zygosity, sex, and developmental stage in shaping the experiences of twins. They emphasize the importance of considering these factors when addressing the needs of twin children. Understanding how zygosity and developmental factors influence emotional and behavioral outcomes can enhance our effective support and promote twins well-being.

## PC-54 Communicative gestures and deception in early childhood

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The ability to deceive first emerges in children around 3.5 years of age (Lee, 2013). Most research on non-verbal deception in children has focused on pointing, a gesture linked to cooperative communication and shared intentionality (Tomasello et al., 2007). Whilst pointing signals communicative intent, reaching is an instrumental action which is not inherently communicative (Sperber & Wilson, 1986). It is therefore likely that children will show differences in both their production and comprehension of deceptive communication when reaching or pointing, though this has not been fully explored. We studied 3-4-year-olds' ability to deceive a competitor and recognise when they had been deceived using pointing and reaching gestures in two competitive games. In the Deception

Game, children had to mislead a competitor by pointing or reaching to an empty cup to win a sticker. To succeed in the Trust Game, participants must recognise that their competitor was pointing or reaching deceptively. Both games consisted of 10 trials, producing 'Deception' and 'Distrust' scores out of 10 for each participant. Standard theory of mind and executive function tests were conducted in a counterbalanced order. Preliminary analyses show that in the Deception Game, gesture type predicts children's ability to deceive. In particular, children have higher deception scores when they reach rather than point, suggesting that the cooperative nature of pointing may make it harder to deceive. Age and executive function also predict children's deception. In the Trust Game, however, only age and theory of mind predict children's ability to detect deception. This suggests that theory of mind is more crucial for detecting deception, while inhibitory control may be more important for producing deceptive acts. This study sheds light on the relative importance of theory of mind and executive function, and further highlights the role of communicative gestures in children's deception.

## PC-55 "Because she's the same as me!" An exploration of children's model choice in social learning experiments

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Selective social learning is thought to play an important role in supporting cumulative culture in humans. Such social learning strategies (SLS) shape how and when observers gather and use information available in their environment. Despite much research exploring how SLSs develop in children, less is known regarding children's active choice of models. Through a series of experiments, we explore how task (task type, difficulty) and model attributes (age, gender, skill) influence whom children choose to observe and how faithfully they copy what they've seen. Children were shown the components involved in construction tasks and then offered a choice of models paired with different types of verbal information about the tasks and the models. Children's choice of model, justification for that choice, and copying fidelity were recorded. We found that children overwhelmingly chose models most like them in age or gender in most conditions, with some switching to older models, or those of a different gender, when tasks were more instrumental in nature or when the described skill of the model changed. The results provide crucial insight into the motivations shaping children's active choice of social information, which in turn has direct implications for cultural evolution in humans.

## PC-56 Self-differentiation in drawings and parental perceptions: Identity construction in twin children pairs

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Being a twin influences a child's self-perception and identity. Monozygotic (MZ) twins, sharing nearly 100% of their genes, typically exhibit greater physical and psychological similarities than dizygotic (DZ) twins, who share about 50%. However, it remains unclear whether twins feel the need to differentiate from their co-twin. This study explored differences in self and co-twin representations in drawings by 68 pairs of Brazilian twins (N=136, aged 6 to 14 years, 50% MZ, 70% girls). Each child was given a paper and colored markers to draw themselves and their co-twin. Based on literature results, we hypothesized that MZ twins would depict more differences between their self and cotwin representation in their drawings than DZ twins. We also hypothesized that closeness, dependence (measured through the Brazilian version of the Twin Relationship Questionnaire) and identity fusion would correlate with these differences. Drawings were rated regarding the absence or existence of differential depictions of 18 body characteristics, and were correlated with parental ratings of twins' closeness, dependence and identity fusion. The analysis did not reveal an effect of zygosity, age, sex and dependence on self-differentiation. However, in DZ twins rated as more fused or similarly close, the drawings showed greater divergence in self-differentiation: one twin displayed low self-differentiation while the co-twin exhibited high self-differentiation (fusion: $p=0.003$, $\rho=0.56$; closeness: $p=0.03$, $\rho=-0.4$). This divergence suggests a compensatory dynamic where one DZ twin asserts individuality more strongly in response to perceived closeness, while the other may not. Given that DZ twins' needs often differ more than those of MZ twins, this differentiation could reflect the necessity for more tailored treatments from others. It may be linked to differences in dominance or parental attention. Further studies on the role of shared social context and parental perceptions in DZ twin relationships could reveal important dynamics in twin identity construction.

## PC-59 Expectations about objects: A pupillometric VoE paradigm

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Infants look longer to a new object after familiarization with object repetitions (Margoni et al., 2024), probably because they form expectations about the next stimulus (Adler & Haith, 2003). However, little is known about psychophysiological correlates of learning in a sequence. As in adults, infants' pupil sizes should decrease across repeated exposure as an index of learning (Marois et al., 2018). Further, if infants learn about objects categories, their expectations might be conceptually broader than when learning about one object exemplar. To test this hypothesis, we implemented a violation of expectation paradigm, measuring pupil size and looking time. 12-month-old infants (N = 47) saw four learning sequences comprising six trials of one object, and four learning sequences comprising

three trials of one standard object and three trials of different objects from the same category. In the test phase, infants saw the standard object, and novel objects of the same category and a different category. We found that pupil dilation increased significantly through the learning sequence ($\beta = 0.13$, $t(1133) = 3.25$, $p = .001$). This stands in contrast to prior work finding a reduction in pupil dilation during learning (Polzer et al., 2023). Although slowly decreasing after the second trial ($\beta = -1.83$, $t(1571.93) = -3.75$, $p < .001$), looking times remained high ($m = 84.52\%$) , suggesting that learning was still in progress. During the test phase, we found a significantly weaker dilation to same category objects compared to standard objects ($\beta = -0.07$, $t(425) = -2.30$ , $p = .022$) after both learning sequence types. Objects from a different category did not elicit significantly different pupil dilations from standard objects and looking times did not differ significantly between test trials. Further analyses will target tonic pupil size and order effects to find explanations for these surprising results.

## PC-60 Cross-cultural differences in altercentric spatial navigation: A comparative study between the UK and China

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Cultural traits are the fundamental basis for formulating the concept of "self," which is crucial for understanding visuo-spatial information from others' perspectives, known as Visuo-Spatial Perspective Taking (VSPT) (Markus & Kitayama, 1991; Nisbett et al., 2001). While cross-cultural differences in processing visual perspectives have been studied (Wu & Keysar, 2007; Wu, Barr, Gann, & Keysar, 2013), their impact on spatial information processing remains underexplored. This study employs a novel task where participants navigate from another's perspective through a series of routes, each with 16 continuous moves, to investigate VSPT between Chinese and UK participants. The results reveal that Chinese participants respond slower in the second move, while similar to British counterparts in the first and last steps. Additionally, when manipulating the angular disparity between the avatar's perspective and self-perspective, Chinese participants exhibit prolonged reaction times during 270° compared to 90° clockwise rotations, whereas UK participants show consistent reactions across angular disparities. These findings suggest that individuals from collectivistic cultures, such as China, may face greater challenges in continuously processing others' spatial information compared to those from individualistic cultures such as the UK (Triandis, 1989; Henrich, Heine, & Norenzayan, 2010).

# BC3D

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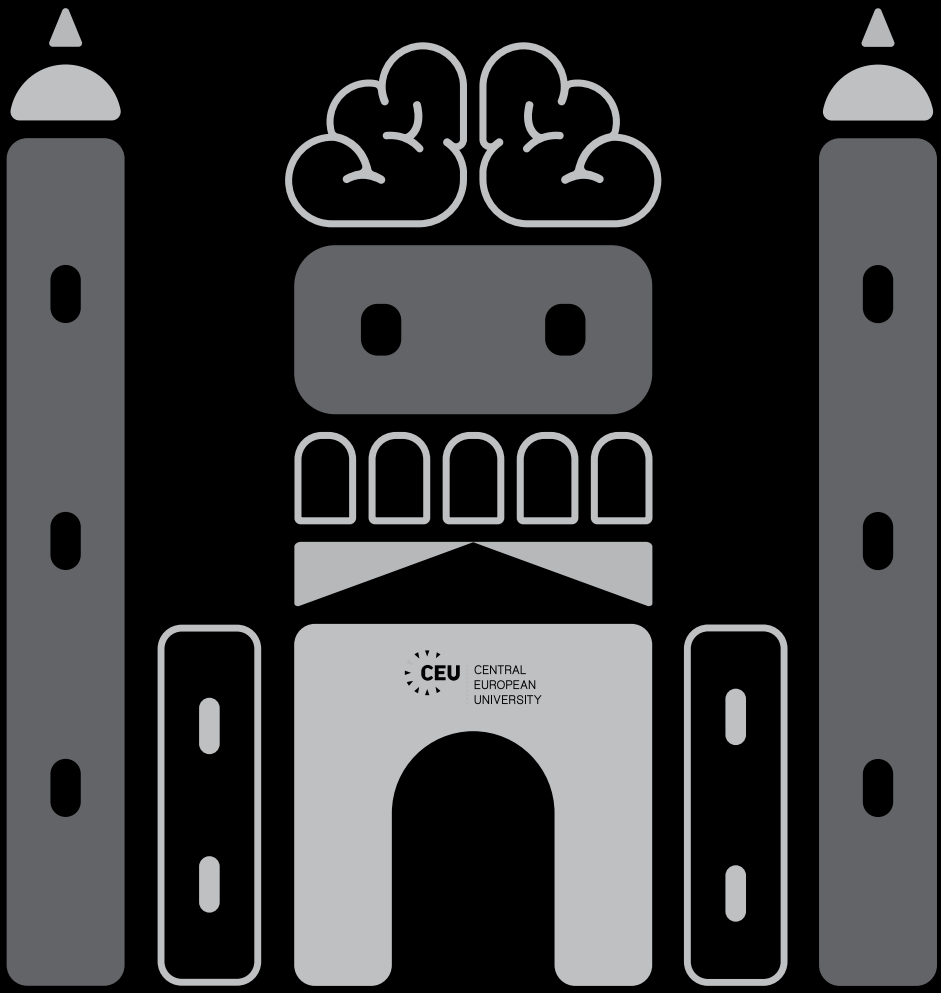
2025



# RESTAURANTS AND MAPS

# FOOD PLACES AROUND CEU

**1. HUMMUSBAR** €
Október 6. u. 19, 1051 Budapest
*Middle Eastern, Street Food, Vegetarian-Friendly*

**2. PASTA CULTURE** €
Október 6. u. 19, 1051 Budapest
*Soups, Sandwiches, Pasta, Pizza*

**3. ISTANBUL KEBAB** €
Október 6. u. 22, 1051 Budapest
*Self-service, Fast food*

**4. DELIBABA** €€
Nádor u. 19, 1051 Budapest
*Soups & Sandwiches, Vegetarian-Friendly*

**5. BÖRZE** €€-€€€
Nádor u. 23, 1051 Budapest
*Hungarian*

**6. HILDA** €€-€€€
Nádor u. 5, 1051 Budapest
*Farm-to-table*

**7. TERV PRESSZÓ** €€
Nádor u. 19, 1051 Budapest
*Hungarian*

**8. TRATTORIA POMO D'ORO** €€-€€€
Arany János u. 9, 1051 Budapest
*Italian*

**9. RETEK BISZTRÓ** €€
Nádor u. 5, 1051 Budapest
*Hungarian cuisine*

**10. BIG FISH** €€-€€€
Zrínyi u. 2, 1051 Budapest
*Farm-to-Table*

**11. BAMBA MARHA** €
Október 6. u. 6, 1051 Budapest
*Burger Bar*

**12. PAD THAI WOKBAR** €€
Október 6. u. 4, 1051 Budapest
*Asian, Fast food*

**13. PIZZA ME** €€
Sas u. 10, 1051 Budapest
*Fast Food*

**14. FRUCCOLA** €€
**(Temporarily Closed)**
Arany János u. 32, 1051 Budapest
*Soups & Sandwiches*

**15. RETRO LANGOS** €-€€
Bajcsy-Zsilinszky út 25, 1065 Bp.
*Hungarian Street Food*

**16. ARTIZÁN BAKERY** €
Hold u. 3, 1054 Budapest
*Pastry, Sandwiches, Vegetarian-Friendly*

**17. BEST BAGEL BASILICA** €€
Zrínyi u. 16, 1051, Budapest
*Sandwich food*

**18. COOKIE BEACON BRUNCH** €€
Hercegprímás u. 15, 1051, Budapest
*Coffee, sweets, eggs, beacon*

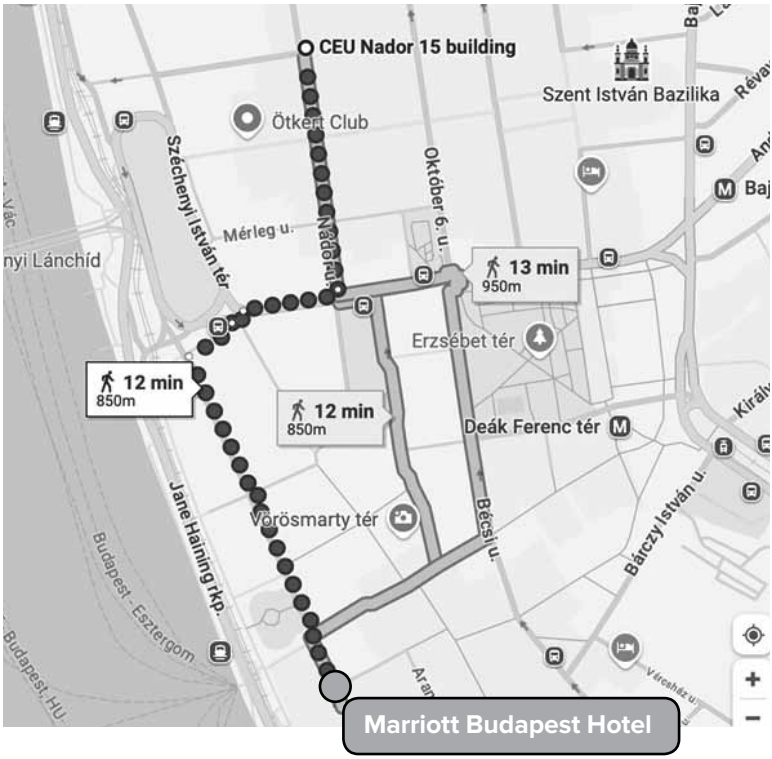
**19 BOMBAY BUDAPEST** €€
Október 6 u. 17, 1051, Budapest
*Indian restaurant*

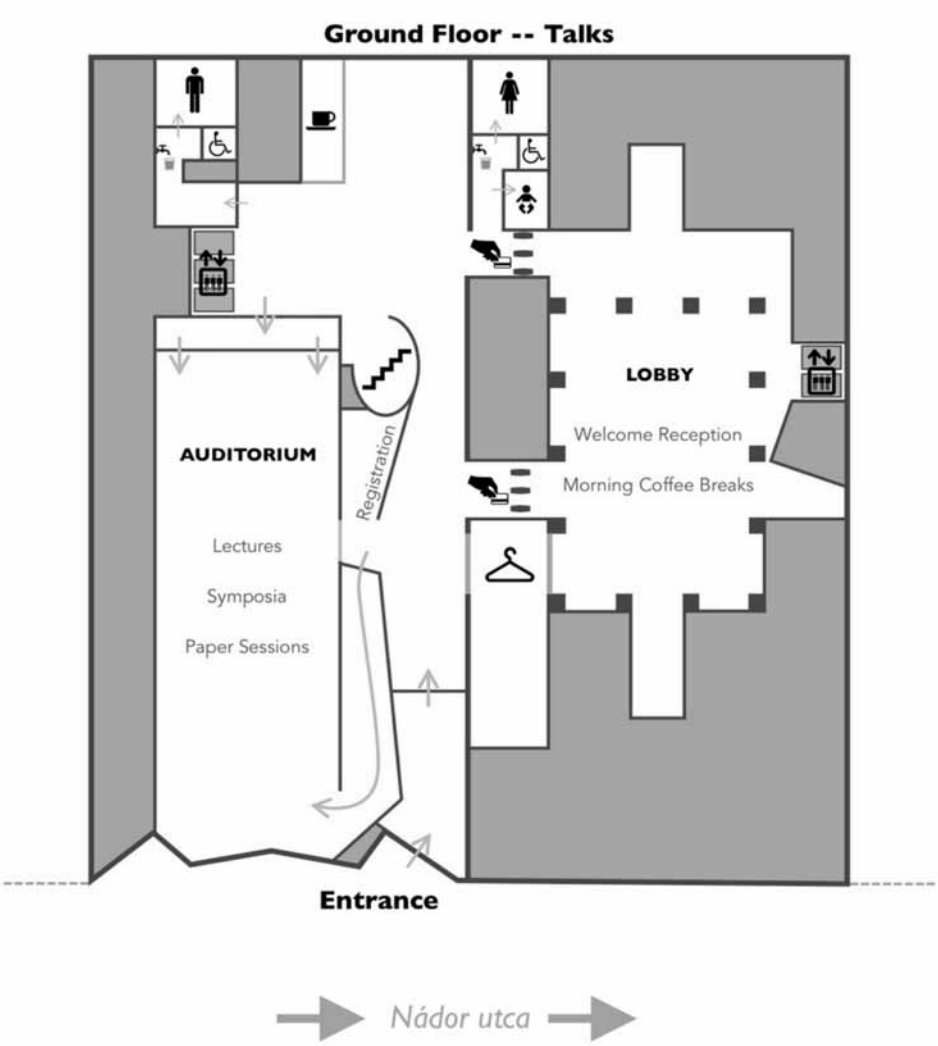
**20. HOPPÁ! BISTRO** €-€€
Október 6 u. 15, 1051, Budapest
*Hungarian restaurant with French twist*

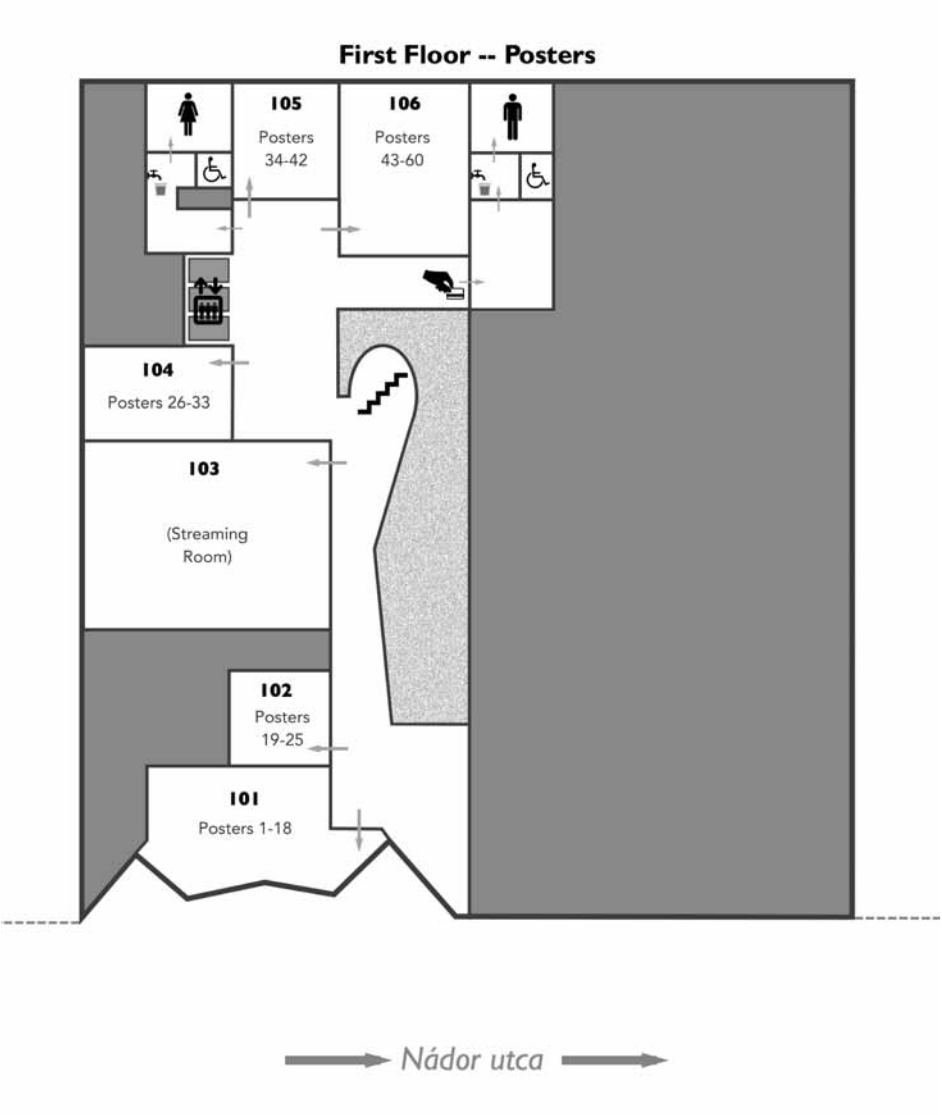
**21. QUÍ RESTAURANT & BAR** €€-€€€
Arany János u. 13, 1051, Budapest
*Thai restaurant*

**22. POKITO** €€
Nádor u. 17, 1051 Budapest
*Hawaii superfood, poke bowls, fish*

**23. CAFE BRUNCH BUDAPEST BAZILIKA** €€-€€€
Zrínyi u. 10, 1051, Budapest
*Sandwiches, egg dishes, vegan, lactose, gluten free meals*


CEU Nador 15 building
Szent István Bazilika
Ötkert Club
Széchenyi István tér
Mérleg u.
Nádor u.
Október 6. u.
13 min
950m
Erzsébet tér
12 min
850m
12 min
850m
Deák Ferenc tér
Vörösmarty tér
Jane Haining rkp.
Budapest - Esztergom
Bécsi u.
Bárczy István u.
Marriott Budapest Hotel

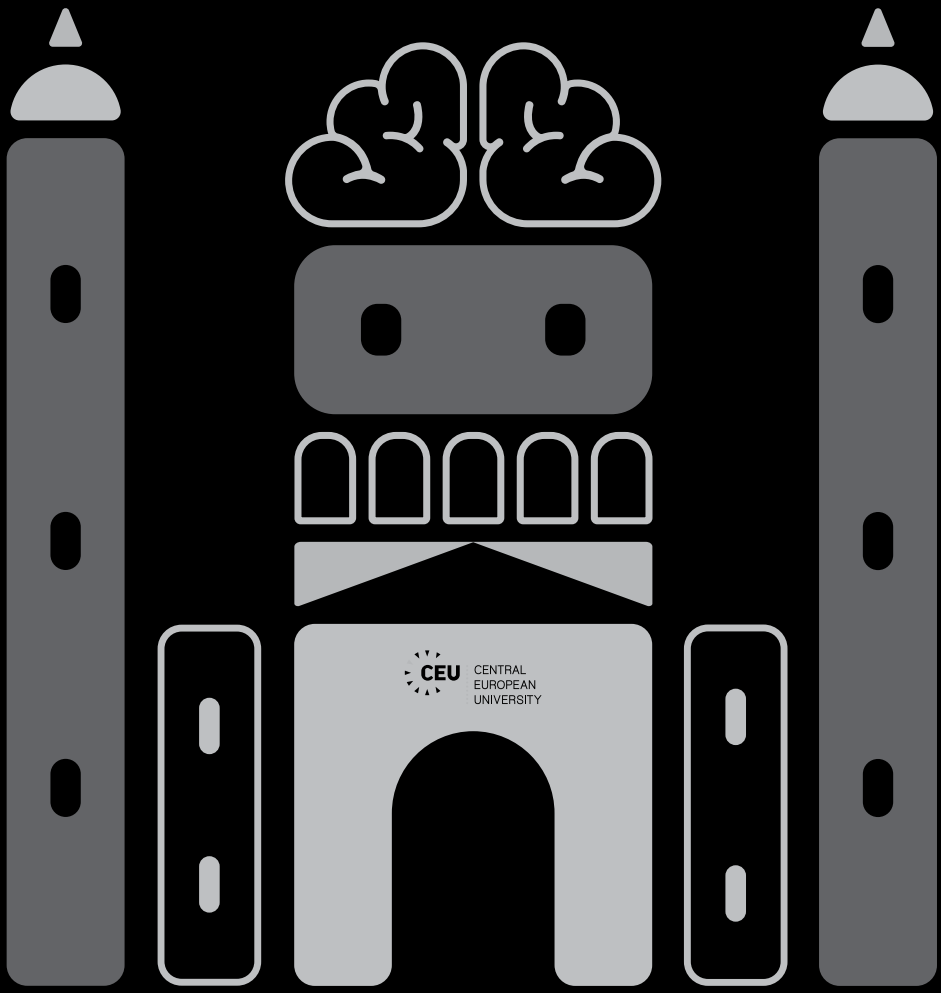

Ground Floor -- Talks
AUDITORIUM
Lectures
Symposia
Paper Sessions
Registration
LOBBY
Welcome Reception
Morning Coffee Breaks
Entrance
Nádor utca


First Floor -- Posters
105
Posters
34-42
106
Posters
43-60
104
Posters 26-33
103
(Streaming
Room)
102
Posters
19-25
101
Posters 1-18
Nádor utca

# BC3D

BUDAPEST
CEU CONFERENCE
ON COGNITIVE
DEVELOPMENT

2025



# NOTES

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