# BC3D

BUDAPEST
CEU CONFERENCE
ON COGNITIVE
DEVELOPMENT

2023
PROGRAM AND ABSTRACTS

CEU CENTRAL EUROPEAN UNIVERSITY

| | Thursday, 5 January | Friday, 6 January | Saturday, 7 January |
|---|---|---|---|
| 08:30 | **Pre-conference events**<br>Cognitive pupillometry<br>*Room 103*<br>Truth, lies and misinformation<br>*Auditorium B*<br>Cross-Cultural Perspectives<br>*Auditorium A* | | |
| 09:30 | | Invited Lecture 2<br>**Anne Christophe**<br>***How do infants acquire words and their meanings?***<br>*Auditorium* | Invited Lecture 3<br>**H. Clark Barrett**<br>***Mind-mindedness and cognitive diversity in moral judgment***<br>*Auditorium* |
| 10:15 | Coffee Break<br>*Lobby* | | |
| 10:45 | **Pre-conference events**<br>Cognitive pupillometry<br>*Room 103*<br>Truth, lies and misinformation<br>*Auditorium B*<br>Cross-Cultural Perspectives<br>*Auditorium A* | Coffee Break + Group Photo<br>*Lobby* | Coffee Break<br>*Lobby* |
| 11:15 | | Paper Session 2<br>**Social Referencing**<br>*Auditorium* | Paper Session 5<br>**Metacognition**<br>*Auditorium* |
| 12:15 | | Lunch Break | Lunch Break |
| 13:00 | Welcoming remarks | | |
| 13:15 | Symposium 1<br>***Infant and Machine Intelligence***<br>*Auditorium* | Symposium 2<br>***The Development of Epistemic and Interpersonal Trust***<br>*Auditorium* | Symposium 3<br>***Learning How to Explore***<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>**Cooperation**<br>*Auditorium* | Paper Session 3<br>**Language**<br>*Auditorium* | Paper Session 6<br>**Theory of Mind**<br>*Auditorium* |
| 17:30 | Short Break | Short Break | Short Break |
| 17:45 | Invited Lecture 1<br>**Kang Lee**<br>***How children learn to tell lies?***<br>*Auditorium* | Paper Session 4<br>**Methods**<br>*Auditorium* | Paper Session 7<br>**Causal Reasoning**<br>*Auditorium* |
| 18:25 | | | Closing remarks |
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# BCCCD 2023

Budapest CEU Conference
on Cognitive Development

## Program and Abstracts

**ORGANIZED BY**
Cognitive Development Center
Central European University

January 5-7, 2023
Budapest, Hungary
http://bcccd.org/

January 12-14, 2023
Online conference
bcccd.slack.com

## 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

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**(Rooftop terrace)**

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## 18:25-18:45 CLOSING REMARKS

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

**(Radisson Blu Béke Hotel)**

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# PRE-CONFERENCE EVENTS

# PRE-CONFERENCE EVENT 1



## Elements of cognitive pupillometry

Thursday, 5 January, 8:30-12:30

**Organizer:**

Giulia Calignano, Università di Padova

Tutorial; limited to 25 participants.

Prerequisites and equipment needed by participants: Basic knowledge of R free software for statistical analysis; personal computer with R installed.
Overview: In developmental psychophysiology, the study of changes in pupil diameter as a response to internal and external stimuli has a long and tortuous history. Nowadays, pupillometry remains a useful method in cognitive sciences as suggested by the increasing number of studies using it to investigate several processes such as allocation of attentional resources, cognitive effort, emotional and language processing, and memory from early infancy to adulthood. The present tutorial offers an introduction to the use of cognitive pupillometry in developmental sciences with practical exercises oriented to explore real data collected from the developmental population. In particular, the tutorial sessions will be enriched by the use of the free software R for data pre-processing and visualization.
Learning aims for participants: Participants will learn: the main sources of noise in the measurement and how to inspect and visualize data with R; the plausible degrees of freedom encountered in data pre-processing and visualization in R; the functional and cognitive interpretation of the signal.
Teaching approach: The teaching approach will be strongly practice-oriented. The use of open tools will be supported by commented examples in order to encourage the use of these software by researchers from as many career stages as possible. However, basic knowledge of R is recommended. All course materials will be shared and made accessible on the OSF platform.
See the OSF page for further details: https://osf.io/qhaf8/?view_only=69e37726e1d7469198dc55628e611812

# PRE-CONFERENCE EVENT 2



## Truth, lies and misinformation during cognitive development

Thursday, 5 January, 8:30-12:30

**Organizer:**

Celeste Kidd, University of California, Berkeley

Workshop; limited to 150 participants.

Program:

Children face the challenge throughout their lifetimes of needing to make decisions based on what is true in a moment, usually without direct access to that truth. Our workshop discusses the learning science and efficacy behind three major approaches to facilitating children's access to truth in the world. Our workshop presents novel developmental science research about how to support children's discovery of truth through interventions that target (1) children's metacognitive awareness, (2) intellectual humility, and (3) understanding of informational ecosystems.

PART 1: METACOGNITIVE AWARENESS

Part one of our workshop presents empirical evidence on how children's metacognitive awareness supports their discernment of truth. Our speakers will discuss how children develop their own metacognitive sense of uncertainty, how training to attend to their uncertainty can improve learning outcomes, and how they integrate their own uncertainty with others' uncertainty. Part one features two speakers with expertise in the development and use of metacognitive cues to uncertainty for learning in children: (1) Carolyn Baer (University of California, Berkeley, United States) will discuss children's ability to track theirs and others' uncertainty to integrate differing opinions in social groups.
(2) Louise Goupil (Université Grenoble Alpes, France) will discuss the results of a metacognitive training intervention that improved learning outcomes.

PART 2: INTELLECTUAL HUMILITY

Part two of our workshop presents empirical evidence that intellectual humility is associated with better discernment of truth, epistemic vigilance, and perseverance in learning. Our talks highlight novel findings on this connection, and work on interventions to pro-

mote intellectual humility in kids in the interest of enhancing curiosity and learning. Part two features two speakers with expertise in intellectual humility and children's learning:
(1) Shauna Bowes (Emory University, United States) will discuss how interpersonal and intrapersonal intellectual humility predict misinformation susceptibility.
(2) Antonia Langenhoff (University of California, Berkeley, United States) will discuss how experiencing disagreement promotes intellectual humility and belief change in children.

PART 3: UNDERSTANDING OF INFORMATIONAL ECOSYSTEMS

In the third and final section of our workshop, we look at the impact of factors outside of children's minds—features of the environments and sources upon which they are basing their truth judgements. Part three of our workshop presents new empirical developmental psychology studies about how children's informational ecosystems—and their understanding of these ecosystems (media literacy)—can promote intellectual humility, epistemic vigilance, and perseverance in learning. Part three features three speakers who are experts in children's learning, media literacy, and learning from new media: (1) Evan Orticio (University of California, Berkeley, United States) will discuss how children increase their evidentiary standards for novel claims in more unreliable informational environments.
(2) Natalia Kucirkova (Open University, United Kingdom) will discuss the implications for learning of using children's personal data in recommender systems (digital personalization).
(3) Costanza De Simone (Max Planck Institute for Human Development, Germany) will discuss how adolescents' online search strategies and level of control affect truth discernment and learning outcomes. This workshop will include time for several discussion sessions, with high involvement from workshop participants, as well as a larger concluding panel to discuss unanswered questions and future directions. The discussions will be moderated by Celeste Kidd (UC Berkeley).

Our workshop will also include breaks for speakers and workshop participants to talk informally about workshop topics. We will summarize the discussion points with an emphasis on unknown questions and potentially fruitful areas for future inquiry at the conclusion of the workshop, which we will circulate to all participants.

# PRE-CONFERENCE EVENT 3



## Cross-Cultural Perspectives on Developmental Cognitive Science

Thursday, 5 January, 8:30-12:30

**Organizer:**

Frankie Fong, Max Planck Institute for Evolutionary Anthropology

Workshop; limited to 150 participants.

Program:

There has been an increasing attention to the issues of WEIRD psychology, where universal assumptions of developmental science are made, based on studies predominantly conducted in certain mainstream Western, English-speaking countries by WEIRD researchers. Beside issues of cross-cultural generalisability, there is also a concern of replicability of previously established phenomena in other populations. Sample more broadly from diverse regions of the world, and greater involvement of researchers from a wider range of countries will provide a more holistic understanding of child development. This will also expand our understanding of the ways cultural factors can influence child development across diverse cultural landscapes, which may be considered an emerging domain of research. Cross-cultural research provides invaluable information about the origins of and explanations for cognitive and behavioral diversity and universality. This workshop will involve talks and discussions that directly address issues of cross-cultural generalizability and replicability in relation to mechanisms of cognitive development. It will focus on theoretical, methodological, practical and logistical aspects of cross-cultural developmental research. We will invite speakers from different fields, covering different approaches and topics. We also welcome posters of study findings or designs (including those from students or ECR) that focus on under-represented populations (including European samples), which can be a single-sample study without necessarily including a comparison sample, or one that focuses on evaluating within-population variations.

Speakers will include: Sarah Pope-Caldwell (Max Planck Institute, Leipzig, Germany), Katja Liebal (Leipzig University), Michaela Slussareff (Charles University, Prague), with more details to follow.

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# INVITED PROGRAM

# INVITED LECTURE 1

## How children learn to tell lies?

Thursday, 5 January 2023, 17:45-19:00

**Chair:**

Gergely Csibra

**Presenter:**

Kang Lee, University of Toronto, Canada

In this talk, I will discuss the work we have been doing for nearly 30 years about how children learn to tell lies from as early as 2 years of age. I will focus on evidence regarding the normative development of lying in childhood and factors that contribute or do not contribute to this development. What I will show is that the development of lying is not a process by which children learn to apply their moral knowledge to practice but rather a process by which children marshal the available cognitive resources to make adaptive behavioral decisions when facing social challenges. When time permits, I will also discuss a new imaging technology called transdermal optical imaging that we invented to use smartphones to detect children's lies remotely and contactlessly, and its applications in psychological, educational, and health research and practice.

# INVITED LECTURE 2

## How do infants acquire words and their meanings?

Friday, 6 January 2023, 9:30-10:45

**Chair:**

Ágnes Melinda Kovács

**Presenter:**

Anne Christophe, CNRS & Ecole normale sup.rieure – PSL, Paris, France

Young children have long been thought to acquire first the sounds of their native language (phonology), then its words (lexicon), then the way in which words are organized into sentences (syntax). This corresponds to what they produce: first they babble (between 6 and 12 months), then they speak in isolated words (1-2 years), and then they start combining words together. Contrary to this simplistic vies, it has been shown that young children start gathering syntactic information much earlier than initially thought, and that they use it to facilitate their learning of word meanings – the syntactic bootstrapping hypothesis (Gleitman, 1990).

Although a wealth of experiments show that infants are able to use the syntactic contexts in which unknown words appear to infer something about their potential meanings, what remains unclear is how children learn which syntactic contexts correspond to which conceptual features – for instance, how do they figure out that words occurring in noun contexts usually refer to objects, and how do they learn the characteristics of noun contexts in their language? Children might learn these by generalizing from a handful of words for which they already have a meaning, a semantic seed. This hypothesis is backed up by computational work, showing that this learning mechanism is feasible, as well as experimental work, showing that toddlers are indeed able to learn syntactic contexts in this way.

# INVITED LECTURE 3

## Mind-mindedness and cognitive diversity in moral judgment

Saturday, 7 January 2023, 9:30-10:45

**Chair:**

György Gergely

**Presenter:**

AH. Clark Barrett, University of California, Los Angeles, USA



In many European philosophical traditions, the moral character of a person's actions depends on their mental states at the time of the act, including their intentions, beliefs, and knowledge. Work in cognitive psychology, developmental psychology and experimental philosophy has provided support for mind-mindedness as a universal feature of human moral psychology. Some anthropologists, on the other hand, have challenged this universalist model, arguing that some moral systems are much less mind-minded than others, with some disregarding mental states altogether. Here I examine cross-cultural evidence that suggests a more nuanced picture than either of these accounts. While there is as yet no evidence of any culture with a completely non-mentalistic moral system, there is considerable variation in how and whether actors' mental states are brought to bear in judging their actions and determining consequences. In some contexts, a mental state that is highly morally relevant in one culture is irrelevant in another. I argue that culture-by-context interactions, rather than wholesale cultural differences in mind-mindedness, are likely to best account for cultural variation in moral judgments. Much work remains to be done to understand these contextual influences on moral judgment, and how and why cultural factors shape them.

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# SYMPOSIA AND PAPER SESSIONS

# SYMPOSIUM 1

## INFANT AND MACHINE INTELLIGENCE IN INTERDISCIPLINARY DIALOGUE

Thursday, 5 January 2023, 13:15-14:30

**Organizers/Chairs:**

Moira Dillon, New York University

Rhodri Cusack, Trinity College Dublin

**Discussant:**

Matthew Botvinick, DeepMind, University College London



**Speakers:**

Moira Dillon, New York University

Koleen McCrink, Barnard College

Cliona O'Doherty, Trinity College Dublin

How might research at the intersection of developmental psychology and machine learning inform and inspire our understanding of both human and artificial intelligence?

The early developing ease with which infants come to have abstract knowledge about foundational content domains of everyday life is impressive, especially compared to the difficulties artificial intelligence has had in achieving these simple human competencies. The powerful learning mechanisms that underlie infants' generalizations in new and dynamic contexts thus seem more powerful than those of any state-of-the-art neural network. Included in this symposium are two talks that focus on infants' everyday, or "commonsense," knowledge about people (talk 1) and objects and places (talk 2), and one talk that focuses on infants' general learning mechanisms and the contexts in which those learning mechanisms operate (talk 3). By showing that infants succeed where machines fail (talks 1 & 2) or by showing that machines succeed when their learning looks more like infants' (talk 3), all three talks suggest that infants have a lot to teach machines. Nevertheless, the research presented in these talks, all led by developmental psychologists, also makes clear that comparing infant and machine intelligence has a lot to offer developmental science aiming to understand human intelligence. For example, talk 1 tests infants on a unified suite, or "benchmark," of tasks probing their expectations about the intentions that underlie others' actions. The results paint a comprehensive picture of infants' com-

monsense psychology and provide a paradigm by which to test infants' comprehensive knowledge in other domains. Talk 2 provides results from suites of tasks, inspired by tasks with infants and children, testing state-of-the-art artificial intelligence. The results suggest both why young children find certain tasks more challenging than others and why human commonsense reasoning about objects and places at times seems so effortless. Finally, talk 3 tests how a self-supervised deep neural network learns using contrastive learning. The results suggest that contrast introduced at different timescales may explain both the network's and infants' learning about objects and the contexts in which they appear. Together, these talks provide evidence that collaboration between the developmental and computational sciences is not only possible but also generative for both fields.
Finally, as an example of this proposed dialogue, we invite after the talks from developmental psychologists a discussant whose expertise in machine learning and artificial intelligence will inspire discussion about whether and how human knowledge can actually be built from the theories we developmental scientists postulate.



## Using a machine learning benchmark to test infant commonsense psychology

**Moira Dillon[1], Gala Stojnic[1], Kanishk Gandhi[2], Shannon Yasuda[1], Brenden Lake[1]**

[1]New York University, USA;[2]Stanford University, USA

A recently proposed machine-learning benchmark, the Baby Intuitions Benchmark (BIB), challenges artificial intelligence to reason about other agents like human infants do by predicting the plausibility of an agent's behavior based on the underlying causes of its actions. State-of-the-art, deep-learning-based agency reasoning models fail on BIB's tasks requiring a representation of an agent's rational, goal-directed actions. Putting infant intelligence in direct dialogue with machine intelligence for the first time, here we test 11-month-old infants on BIB. Following a preregistered design and analysis plan, we collected 288 individual datasets of infants' reasoning about agents. While BIB presents rather minimal representations of agents and objects, challenging the abstractness of infants' knowledge, infants nevertheless succeeded in predicting an agent's rational, goal-directed actions towards objects. Moreover, infants showed no predictions about whether different agents would share goals or how agents would act when their goal is inaccessible or requires an instrumental action (e.g. the use of a tool), thereby addressing incomplete or mixed results in the previous literature on infants' action understanding. Our findings reveal essential properties of human's early emerging knowledge about agents, and BIB serves as a model for revealing the foundational knowledge that humans possess both within and across core content domains of everyday life.

## The Evaluation of Artificial Intelligence: Harnessing Developmental Psychology Theory and Methods

**Koleen McCrink[1], David Moore[2], Lisa Oakes[3]**

[1]Barnard College, USA;[2]Pitzer College, USA;[3]University of California - Davis, USA

Developmental psychologists studying early cognition and researchers studying artificial intelligence (AI) can work to mutual benefit. Scientists who develop commonsense AI can study and implement early cognitive capacities and their interactions, and developmental psychologists can draw theoretical and practical conclusions by examining how AI systems perform in various tasks. Discovering what commonsense capacities AIs can and cannot easily learn highlights the difficulties associated with certain tasks, perhaps helping to explain why young children find such tasks challenging – or raising questions about how they succeed as well as they do. In this talk, we describe findings from the DARPA Machine Common Sense program, which was designed to foster cross-talk between AI researchers and psychologists studying the development of early cognition. As evaluators in this program, we develop tasks for AIs that mirror those used in some developmental psychology experiments. We will provide an overview of the content and experimental tactics used in this evaluation program, which assesses AIs using a battery of tasks that tap into commonsense concepts of objects, places, and agents. These tasks require the AIs to either passively watch a scene and detect a violation of a commonsense principle, or seek out a target object in a navigable environment. We will discuss two case studies (spatial reorientation and occluded object reasoning) that highlight the complexity of interactions between "low-level" visual systems and "high-level" abstract principles in both infants and AIs, and that offer insight into the suite of human factors that make our commonsense reasoning seem effortless.



## Infant-inspired contrastive learning of naturalistic temporal regularities in a deep neural network

**Cliona O'Doherty, Rhodri Cusack**

Trinity College Dublin, Ireland

Infants develop rich knowledge of the things they see, such as what something looks like, where it typically occurs, and what it's similar to. Developmental science has shown that this learning occurs through comparison, statistical learning and the relating of inputs over

time with the ultimate neural site of many rich representations being the ventral visual cortex. Deep neural networks (DNNs) are proving to be promising models for the ventral cortex; yet, these DNNs are lacking in how they learn when compared to infants. Their entire visual experience is static, supervised and missing the rich associations present in dynamic naturalistic experience. We explore an infant-inspired learning mechanism with a self-supervised DNN using contrastive learning to find commonalities in naturalistic video over various timescales. We hypothesized that commonalities across longer timescales (e.g., one minute) would reflect scene context, which changes relatively slowly. We assessed learned representations with independent test images in which objects or backgrounds were manipulated and found that the temporal contrastive learning approach led to representations that reflected background context more than a baseline supervised network, which learned an object-centric embedding. However, at longer (5 min) timescales, object and context knowledge were both learned. Our results demonstrate that temporal structure in naturalistic visual inputs can be a powerful resource for learning visual representations in DNNs – just like in infants – and illuminate the potential of using inspiration from infant developmental science to improve computational models for both computer vision and neuroscience.

# PAPER SESSION 1

## COOPERATION

Thursday, 5 January 2023, 16:30-17:30

**Chair:**
Barbu Revencu

### What do preschoolers mean by 'helping'?

**Laura Schlingloff-Nemecz[1], Barbara Pomiechowska[1], Denis Tatone[1], Gergely Csibra[1,2]**
[1]Cognitive Development Center, Department of Cognitive Science, Central European University, Vienna, Austria;[2]Department of Psychological Sciences, Birkbeck, University of London, UK



Instrumental helping is one of the paradigmatic "prosocial" behaviors featured in developmental research on sociomoral reasoning. Although this research presupposes that young children understand helping, the questions of how they identify instances of helping behaviors in third-party interactions and what it means to 'help' have hardly been addressed. In the framework of the naïve utility calculus — a theory of action understanding according to which people interpret others' behaviors as directed at maximizing their utility (Jara-Ettinger et al., 2016) — helping can be described as an action with the goal of increasing the utility of a Helpee by reducing their costs of goal completion (Ullman et al., 2009; Powell, 2021). Here, we tested whether this description adequately captures children's concept of helping by examining whether three-year-olds (1) take the verb 'to help' to refer to interventions that maximize cost reduction for a Helpee, and (2) use this concept to identify which of two agents performing superficially similar interventions on the constraints of a Helpee's action actually helped.

Children were familiarized with an animated character (Protagonist, P) whose goal was to approach and collect resources, sometimes by detouring around obstacles. In one set of test trials (Block 1), children themselves were asked to help P by moving one of two obstacles. While removing either obstacle allowed the agent to access the resource, one of them freed a shorter path, either to the only available resource ("two paths" trial; Fig. 1), or to one of two resources located closer to the agent ("two objects" trial; Fig. 2).

In a second set of test trials (Block 2), children observed two agents move obstacles, and were asked which one helped P. One agent acted in a helpful way (i.e., removed an obstacle that let P take a shorter path to the goal), whereas the other moved either an obstacle

that was not blocking P's path ("helper/non-helper" trial; Fig. 3), or moved an obstacle into P's shortest path to the resource, thus increasing P's cost ("helper/hinderer" trial; Fig. 4). Neither situation (a) required helping (P could achieve her goal without intervention at a higher cost), or (b) included cues of direct social interaction between the agents.
If children adopted a concept of helping grounded purely in cost reduction, they should (1) intervene on the constraints that P faces such that P's utility is maximized, and (2) choose an agent who increases P's utility in this way as the one who helped. We aim to test n = 64 participants (3.0 ≤ age < 4.0 years). Data collection takes place virtually via Zoom and is ongoing. The experiment was preregistered at the OSF: https://osf.io/v4yeg/?view_only=9086b9412d4b4e929615a19b35858dd4.

## Development of intergroup bias in children's third-party punishment decisions

**Maria Luz Gonzalez-Gadea[1,2], Agustin Petroni[2,3,4]**

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From their earliest years, children intervene protesting to antisocial agents, and gradually become agents of justice themselves, by acting as third parties and punish transgressors of social norms, even at a personal cost—a phenomenon known as Third Party Punishment (TPP). This behavior is not impartial, as children preferentially punish some transgressors more than others, exhibiting intergroup biases. Two opposing hypotheses have been proposed to explain intergroup biases during TPP (McAuliffe & Dunham, 2016): the Norms-Focused Hypothesis proposes that given that groups serve to foster cooperation, individuals are more willing to punish transgression from ingroup members than from outgroup members, a bias called ingroup policing. Also, this hypothesis predicts that individuals are more likely to punish transgressions that are directed at ingroup than at outgroup recipients/victims, showing an ingroup protectionism bias. Contrarily, the Mere Preferences Hypothesis proposes that because groups are closely linked to the self, ingroup members are viewed more positively than outgroup members and therefore, this hypothesis predicts that individuals will more frequently punish outgroup than ingroup transgressors, exhibiting ingroup favoritism bias.
In this study, we tested theses hypotheses in children between six and 11 years of age

(N=124) using a modified TPP task developed by Jordan et al. (2014) in which a participant chose her/his group membership and then observed allocation distributions between ingroup and outgroup members in which one player (i.e., a transgressor) refused to share resources (pieces of candy) between himself/herself and another player (i.e., a recipient). The participant had to decide whether to accept or reject the transgressor's selfish allocation. If the participant accepts the allocation, the transgressor will obtain the pieces of candy, while if the participant rejects the allocation, the transgressor will not obtain the resources. Thus, rejection means a punishment to the transgressor. We explored the mechanisms associated with intergroup biases in TPP by measuring Reaction Times (RT) during TPP decisions (see Figure 1, left).

Our results supported the Norms-Focused Hypothesis: children showed an ingroup policing bias, as they more frequently punished ingroup members than outgroup transgressors and they also showed an ingroup protectionism bias, as they were more willing to punish selfishness directed at an ingroup recipient than at an outgroup recipient. We observed different developmental trajectories and mechanisms associated with these biases. First, while ingroup protectionism was present in all children, ingroup policing decreases with age and it was absent in children between 10 and 11 years of age (see Figure 1, right). Second, regarding the mechanisms associated with these intergroup biases, we observed longer RT during both ingroup policing and protectionism biases and an association between RT and decisions, which suggest that intergroup bias decisions involve a more deliberative/conflictive than automatic process.

These results shed light on the mechanisms that underlie the development of intergroup bias in TPP decisions, and could help to understand how to intervene to diminish intergroup biases in children.



## Testing puppetry to simulate peer interactions in child development research

**Roman Stengelin[1,2], Patricia Kanngiesser[3], Daniel Haun[1]**

[1]Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany;[2]University of Namibia, Windhoek, Namibia;[3]University of Plymouth, Plymouth, UK

Social interactions with adults and peers provide young children with essential experience to develop and refine their social cognition and behaviors. However, studying peer interactions in rigorously standardized experiments is often challenging and at times impossible. As a compromise, researchers commonly employ puppets, animated by adult experiment-

ers, as stand-ins for peers. This practice is based on the assumption that puppets reduce social hierarchies between children and adult experimenters akin to peer interactions. Even though puppetry is commonplace in social development research, there have been debates about its ecological validity.

In two preregistered studies, we asked whether children's social cognition and behaviors with puppets resemble those shown with peers (i.e., puppet-as-child hypothesis), adults (i.e., puppet-as-adult hypothesis), or neither (puppet-as-puppet hypothesis). First, we investigated children's imitation of causally irrelevant actions (i.e., overimitation) from puppet, child, and adult models among N = 72 urban German children (AgeRange = 4.6 - 6.5 years) via a mock video call. Results of this study indicate that children commonly overimitate puppets, but that they are more likely to copy irrelevant actions from adults and peer models. In a second study, we investigated puppetry in the context of children's normative protest, their instrumental helping, and their false belief understanding in face-to-face interactions. Furthermore, we assessed whether German children (N = 149; AgeRange = 3.5 - 4.5 years) would ascribe agency and experience to puppets, peers, and adults. Children were less likely to ascribe agency and experience to puppets than to peers or adults. At the same time, their social cognition and behaviors (i.e., normative protest, instrumental helping, false belief understanding) was robust to partner characteristics.

Taken together, we conclude that children employ realistic social cognition and behaviors when engaging with puppets in child development research while being aware that puppets are not real-world human partners. At the same time, we present a cautionary note on puppetry to simulate peers in child development research: Adult partners evoke equally, if not more realistic behaviors akin to peer interactions than puppets.

# PAPER SESSION 2

## SOCIAL REFERENCING

Friday, 6 January 2023, 11:15-12:15

**Chair:**
Maja Blesic

### Observed joint visual attention enhances 9-month-old infants' selective processing of recognition-relevant object features

**Maleen Thiele[1], Steven Kalinke[1], Christine Michel[2], Daniel B.M. Haun[1]**
[1]Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany;[2]Leipzig University, Leipzig, Germany



Previous research has shown that observing two people sharing joint visual attention to an object increases 9-month-old infants' object encoding (Thiele et al., 2021). The current study investigated the specificity of this memory-enhancing effect. Based on previous infant studies suggesting a "communication-induced memory bias" in self-experienced interactions (Okumura et al., 2016; Yoon et al., 2008; but see Silverstein et al., 2019), we aimed to examine whether observed joint attention biases preverbal infants to encode qualitatively different object properties compared to observed social situations lacking interpersonal sharedness.
In Experiment 1, N = 36 9-month-old German infants participated in a screen-based violation-of-expectation task during which they saw two kinds of videos showing two adults looking at an object (Figure 1). Depending on the condition, the actors' object-directed look was embedded within a joint attention context including eye contact or a parallel attention context lacking eye contact. Following an occlusion phase, infants saw one of three different outcomes: the same object reappeared at the same screen position (no change), the same object reappeared at a novel screen position (location change), or a novel object appeared at the same screen position (identity change). As the dependent variable, we measured infants' first look duration at the change outcomes and compared it with their first look duration at the no change outcome. We assumed that relatively longer looking times would indicate that infants had processed and retained the changed feature in their memory. We found that infants looked longer at identity changes (vs. no changes) in the eye contact condition compared to the no eye contact condition (interaction between eye

contact and identity change: $\chi2(1) = 37.82$, $p < .001$), whereas infants' response to location changes was not influenced by the presence of eye contact (interaction between eye contact and location change: $\chi2(1) = 0.39$, $p = .55$, Figure 2a).

In Experiment 2, N = 36 9-month-old German infants participated in a matched first-party task, during which they saw one single adult on screen looking either in the direction of the infant (eye contact) or to the side (no eye contact) before looking at an object. Like in Experiment 1, we found that eye contact modulated infants' looking times at identity changes ($\chi2(1) = 15.39$, $p = <.001$) but not location changes ($\chi2(1) = 0.04$, $p = .85$, Figure 2b).

Together, these results align with the idea that interpersonal sharedness about an object enhances 9-month-old infants' selective processing of internal object features over transient spatial features, increasing their chances to recognize and learn about an object in the future. By comparing infants' responses in a first- and third-party context, we could show that this memory bias extends to observational settings and is not restricted to infant-directed cues—even within a socialization context where observation does not represent the primary mode of social learning. We will discuss our findings in the light of the replication crisis and situate their implications within the context of the growing literature emphasizing third-party observation as an effective strategy for early cultural learning.



## The development of gaze understanding across (at least) 6 diverse societies

**Julia Prein, Damilola Olaoba, Roman Stengelin, Manuel Bohn, Daniel Haun**

Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany

To navigate the social world and interact with other agents, we use social cognition. Much research has been devoted to studying the average age at which a certain social-cognitive ability emerges in development. Individual-level and cross-cultural variation has often been overlooked in research on social-cognitive development. This is problematic because developmental theories emphasize the role of social interaction on the development of social cognition which varies substantially across individuals and cultures.

In this study, we aim to capture individual-level variation in social cognition across cultures and to explore the role of family-level demographics. We concentrate on an essential ability that is involved in many social-cognitive processes: gaze understanding – the ability to locate and use the attentional focus of an agent. In our tablet-based task, we ask participants to locate a balloon with the help of a gaze cue. We designed a spatial layout and applied a continuous measure of participants' touch imprecision. For this purpose, we implemented a new interactive web interface that works across devices and enables

supervised and unsupervised, as well as inperson and remote testing. Minimal language demands and the web-app implementation allow for fast and easy contextual adaptation to each cultural setting.

To conceptualize and interpret individual differences in a psychologically meaningful way, we formalize the understanding of gaze cues in a cognitive model. The key parameter in this model is an inferential component, which describes how accurate the participant is in inferring the target's location based on the agent's gaze. In addition, the model estimates the probability that the participant uses the available gaze information or engages in guessing. Our sample consists of children between 2.5 and 8 years of age from urban and rural communities in Nigeria, Sambia, Namibia, USA, and Germany (data collection still ongoing, N at date of submission = 286). Preliminary results show substantial individual differences in children's imprecision in locating the target. Across cultural settings, we see similar substantial developmental gains: the older children are, the more accurately they locate the target. Via our model, we can identify a dual developmental process that explains why children get more precise. With increasing age, children (A) become more likely to use the gaze cue in the first place, and (B) when they do so, they use the gaze cue more accurately.

Additionally, we will explore the relationship between gaze understanding and family-level demographics (e.g., household size; family constellation; screen exposure). Taken together, this work shows how a focus on individual and cross-cultural variation enables us to capture underlying characteristics in social-cognitive development and their relation to environmental and familial factors.



## A multi dimensional study on humor and learning in infancy

**Romain di Stasi, Lauriane Rat-Fischer, Fabien Cerrotti, Rana Esseily**

Laboratoire Éthologie Cognition Développement (UR LECD), Paris Nanterre University, Nanterre, France

Humor has a positive influence on learning in adults and school-aged children (1), yet few studies investigated the effect of humor on learning in infants. Our team was the first to show an influence of humor on social learning in infants as young as 18 months in a tool use context (2). In this earlier study, 64 infants had to use a rake to retrieve an out-of-reach toy after a demonstration of its use by an experimenter. The demonstration was done either in a humorous or in a neutral way. Our team found that 94% of the infants who laughed when exposed to a humorous demonstration then reproduced the target action compared

to only 20% of infants who did not laugh or were exposed to the neutral demonstration. These results may be driven by different factors such as positive emotions, a surprise effect or the intensity of the emotions as measured by physiological parameters. The first aim of the current study was to understand the physiological/emotional mechanisms involved in the link between humour and learning by using a mutlidimensional approach. The second aim was to assess the generalizability of the previous findings on a larger age group (120 infants), aged between 14 and 22 months. In addition to the behavioral analysis, we measured several variables: both cardiovascular data by means of a wristband (to measure the intensity of emotions in a non invasive way); an automatic facial expression analysis; and a temperament measure by means of the ECBQ questionnaire, in order to investigate inter-individual differences in infants' reactions to a humorous demonstration (3). Through this study, we investigated (a) the potential relationship between emotional intensity and learning in a humorous context, (b) whether infants under 18 months of age can learn better with humor, and (c) at what age infants consider our humorous demonstration to be funny. Our preliminary analyses of the physiological data seem to show no differences in infants' heart rates both between (1) the neutral and the humorous demonstrations, and (2) between laughing, smiling and neutral infants. Therefore, we found no effect of the intensity of emotions on learning (see figure 1). Infants seemed to learn better when they were exposed to a humorous demonstration, as shown on figure 2. Furthermore, infants who smiled or laughed during the demonstration imitated more than non-laughing infants exposed to a neutral or humorous demonstration (see figure 3). The perception of the specific type of humor used in our study (measured by the laughing reaction) develops around 17 months of age. Surprisingly, our temperament questionnaire analysis suggested that laughing infants had more difficulty than others in regulating their negative emotions (figure 4). Further analysis of the cardiac signal are ongoing, to focus on the shape of the cardiac waves, correlated with facial expression analysis. These additional analysis seek to evaluate the effect of other positive emotions such as joy and surprise, both known to have a positive influence on learning in adults (4; 5).

# SYMPOSIUM 2

## THE DEVELOPMENT OF EPISTEMIC AND INTERPERSONAL TRUST: THE CASE OF DOMINANCE

Friday, 6 January 2023, 13:15-14:30

**Organizers/Chairs:**

Thomas Ganzetti, University of Neuchâtel, Switzerland

Thomas Castelain, University of Girona, Spain

**Discussant:**

Melissa Koenig, University of Minnesota, USA



**Speakers:**

Thomas Castelain, University of Girona, Spain

Francesco Margoni, University of Oslo, Norway

Thomas Ganzetti, University of Neuchâtel, Switzerland

Hierarchies and dominance relationships are ubiquitous among humans, with high-ranking dominant individuals having a priority access to resources and exerting influence over others' behavior and beliefs. In fact, dominance is thought to play a relevant role in epistemic and interpersonal trust, being perceived as a cue of trustworthiness.

Nevertheless, much remains to be understood concerning (i) whether dominance is judged and valued differently across cultures, (ii) how different types of social power are detected and if they produce different effects on learning processes and cultural transmission, and (iii) how dominance cues interact with other socially relevant cues for epistemic trust, such as the majority's opinion. In this symposium, researchers from three international labs further investigate these crucial aspects of dominance with a developmental perspective.

The first contribution explores the presence of possible cultural differences in young children's use of dominance cues when determining the reliability of testimonies, as dominance might be valued differently (positively or negatively) depending on cultural contexts. The study was conducted on children from three different countries: France, Guatemala, and Japan. Results indicate that French and Mayan children endorse the testimony of the dominant over that of the subordinate, whereas Japanese children trust more the subordinate. These findings suggest that preschoolers take dominance into account when evaluating testimony, but their valuing of dominance seems to be influenced by local cultural norms.

The second contribution focuses on the distinction between respect-based dominance ("leadership") and fear-based dominance ("bullying"), exploring whether children tend to trust a leader more than a bully. Three studies investigated the presence of possible developmental effects in epistemic and interpersonal trust, finding that young toddlers trust more a bully than a leader, whereas older toddlers and school-age children show the opposite bias. These findings indicate that the sensitivity to respect-based power cues might emerge only in a second moment, and that the type of social power displayed by an individual affects children's learning and interpersonal processes.

The third contribution examines whether dominance cues are relevant for epistemic trust also when the claims provided by a dominant individual (either a "bully" or a "leader") contrast with the majority's opinion (consensus). Furthermore, it focuses on the presence of possible differences between preschoolers' and adults' attribution of trust based on dominance and consensual cues.

The results of the study suggest that when the majority's opinion is available, dominance cues are no longer relevant, and epistemic judgments are based on consensual cues regardless the claims provided by a dominant. Moreover, children are sensitive to consensual cues even more than adults.

Collectively, this symposium addresses a number of aspects concerning the development of children's detection and use of dominance in epistemic and interpersonal trust. Our discussant will outline a more comprehensive interpretation of these findings, linking them to different theoretical frameworks and highlighting how developmental research on the relationship between trust, dominance, and sensitivity to other social cues is crucial to understand how humans navigate their complex social environment from very early in life.



## Is the boss always right? Evidence from preschoolers from three different cultures

**Thomas Castelain[1], Stephâne Bernard[2], Mioko Sudo[3], Hugo Mercier[4]**

[1]University of Girona, Spain;[2]University of Neuchâtel, Switzerland;[3]University of Florida, USA;[4]CNRS, France

Several experimental studies have demonstrated that young children can infer dominance from a variety of relational cues (physical supremacy, holding resources, decisional power) but it is less clear whether and how dominance affects trust in testimony. Moreover, it has been suggested that vertical individualist cultures (such as the U.S. and France) and vertical collectivist cultures (such as Japan) treat dominance differently. Because dominance can

either be viewed from a positive or a negative perspective, the evaluation of dominance might partially depend on the weight placed by culture on each perspective. Thus, studying the effects of dominance in different cultures could help better understand its impact on trust in testimony. Using a selective trust paradigm, we investigated how children from France (3 to 5-year-olds; N = 74), Guatemala (4 to 6-year-olds; N = 97) and Japan (5-year-olds; N = 44) endorse the testimony of a dominant and a subordinate informant. This series of experiments revealed that French (68% of choices linked to the dominant) and Mayan (61.3% of choices linked to the dominant) children tend to follow the testimony of the dominant, while Japanese (31.4% of choices linked to the dominant) participants tend to favor the testimony of the subordinate. Our findings suggest that preschoolers take dominance into account when evaluating testimony, but their valuing of dominance is influenced by local cultural norms. Further research is needed to disentangle the nature of the inferences children make based on dominance and how culture can modulate the valuing of this social cue.



## The development of epistemic and interpersonal trust in individuals displaying respect-based vs. fear-based social power

**Francesco Margoni**
University of Oslo, Norway

Previous research has shown that already in toddlerhood, children can tell respect-based power exerted by a leader from fear-based power exerted by a bully. With three studies, we further asked whether children trust leaders more than bullies, and investigated possible developmental effects both in epistemic and interpersonal trust. In the first study, two groups of toddlers (16 younger toddlers, 18-32 months; 16 older toddlers, 24-30 months) were presented with agents characterized as either a leader or a bully (based on cues used in prior studies), and saw a scene where the leader and the bully labelled in the same way ("This is a zaffo!") each a different novel object. When asked to give a zaffo to the experiment, most of the younger toddlers selected the object labelled by the bully, whereas most of the older toddlers selected the other object, suggesting that they trusted the leader. In a second study, employing a similar procedure, we found that the same proclivity to trust the leader more than the bully characterized school-age children's choices (N=219, 6-10 years). Last, in a third study, we investigated interpersonal trust in preschool- (N=46, 4-5 years) and school-age children (N=32, 7-8 years). By using a child-friendly version of the Trust Game, we found that in both groups children invested their resources more

in the leader than in the bully. Overall, these data suggest that the type of social power displayed by who is in charge can shape children's learning and interpersonal processes from very early in life.

## What to believe? The relevance of non-verbal consensual cues and dominance relationships in the evaluation of testimony

**Thomas Ganzetti, Gökhan Gönul, Fabrice Clément**
University of Neuchâtel, Switzerland

Previous studies highlighted children's sensitivity to two social cues for epistemic trust: dominance and consensus. However, it remains unclear if children, when determining the reliability of incoming information, are more sensitive to the dominance rank of an informant or to the majority's opinion. Furthermore, previous research did not investigate whether children and adults display differences in their use of these social cues when evaluating testimony.

This pre-registered study investigated adults' and 3- to 5-year-olds' sensitivity to non-verbal consensual cues and to dominance cues, to determine which one is more relevant for epistemic trust when they are put in contrast. In two experiments, a dominance asymmetry between two characters was established based on physical power (experiment 1: "Bully") or prestige (experiment 2: "Leader"). Participants were then presented with two testimony tasks in which a dominant individual and a subordinate provided contrasting information, while two bystanders either approved or disapproved their claims. In experiment 1, we found that adults (N=42) and children (N=23) relied significantly more on non-verbal consensual cues than on dominance cues based on physical power, trusting the claims given by the informant receiving approval, regardless of him being the dominant or the subordinate. Preliminary results from experiment 2 suggested that participants display the same tendency even when the dominant is a "leader" and not a "bully"; datacollection will be completed in August-October 2022. The results of this study bring a relevant contribution to current research on the cognitive and affective mechanisms employed by humans to evaluate communicated information

# PAPER SESSION 3

## LANGUAGE

Friday, 6 January 2023, 16:30-17:30

**Chair:**

Magdalena Roszkowski

### Prosody can guide French children's interpretations of ambiguous relative clauses

**Leticia Kolberg, Alex de Carvalho**

Laboratoire de Psychologie du Développement et de l'Éducation de l'Enfant (LaPsyDÉ, Université Paris Cité, CNRS, Paris - France)



Several studies show that implicit (silent) prosodic representations can influence the parsing and comprehension of written sentences in adults [1-3]. When reading sentences with relative clauses (RCs) such as "He knows the daughter(N1) of the man(N2) who waits", readers tend to impose an implicit prosodic break after the first noun (N1, e.g., "[He knows the daughter(N1)][of the man(N2) who waits]", which leads them to interpret the second noun (N2) as the subject of the RC (i.e., "the man is waiting"). However, when reading a longer sentence containing the same words/ambiguity, they tend to impose a prosodic boundary after N2 (e.g., "[He knows the daughter(N1) of the man(N2)][who waits in the kitchen]"), which leads them to interpret N1 as the subject of the RC (i.e., "the daughter is waiting"). However, there are still no studies investigating when children start relying on prosodic information to constrain their interpretations of relative clauses in the reading and spoken domain. Crucially, recent studies suggest that when processing complex syntactic structures with optional prosodic boundaries, children have trouble using prosodic information to constrain their parsing (see discussion in [4-6]).

To investigate these issues, we tested French-speaking children's interpretation of RCs in two modalities: spoken sentences (with 7-to-9-year-olds (N=28) and 4-to-6-year-olds (N=27)) and written sentences (with 8-to-9-year-olds, N=20). With spoken sentences, children heard long-RC sentences containing a prosodic boundary either after N1 or after N2, as in the examples above. In the reading task, children read aloud either long- or short-RC sentences. Afterwards, participants heard or read a question such as "who waits?" while seeing two images side-by-side: one representing the N1 interpretation (e.g., a girl) and

another representing the N2 interpretation (e.g., a man), and were asked to point towards the right answer (Fig.1). With spoken sentences, the results showed that both age groups can successfully use prosodic information to guide their interpretations of RCs (see Fig.2). Although they showed an overall preference for choosing N1 as the referent of long-RC sentences, they chose N1 more often when listening to long-RC sentences with a prosodic boundary after N2 than after N1 ($\beta$= 0.84, SE=0.32, z=2.58, p<.01). The preliminary results of the reading task with 8-to-9-year-olds (see Fig.3) shows the same tendency, with children choosing N1 more often when reading long-RC than short-RC sentences. However, the effect of condition is not significant yet ($\beta$= 0.51, SE=0.36, z=1.43, p=.15).

These results show for the first time that from age 4, children can use prosodic information in speech to constrain their interpretation of ambiguous relative clauses, even though these are complex structures with optional prosodic boundaries. Furthermore, by age 8, they seem to be able to generate representations of sentence intonation (i.e., prosodic phrasing) when reading sentences, which may in turn affect their interpretations. This suggests that both explicit and implicit prosody can influence online sentence parsing in children, and should therefore be included in models of children's spoken and written sentence processing and in methods of reading instruction in children.



## Mathematical language and mathematical abilities: differences in monolingual and multilingual children

**Eylül Turan, Bert De Smedt**
KU Leuven

Children's understanding of mathematical language is critical for their mathematical abilities, and there is an increasing body of evidence showing that there is a strong association between mathematical language and mathematical performance (e.g., Turan & De Smedt, 2022). Most of this evidence has been restricted to children, who show proficiency in only one language, usually in English (e.g., Bower et al., 2020; Purpura et al., 2016). However, there is evidence to suggest that second language learners show poorer mathematical language skills compared to their monolingual peers (Peng et al. 2020). As a result, growing up in a multilingual environment might be a risk factor for subsequent difficulties in mathematical language and mathematical ability. We examined the associations between different types of mathematical language, such as quantitative (e.g., more) or spatial language (e.g., above), and different mathematical abilities, including numerical competencies, measurement and geometry, in multilingual children. Our sample consisted of 154 4-5-year-old children. It included 77 monolingual and 77 multilingual children that

were matched in terms of age- and sex (Mage = 4 years 8 months and 33 females in each group) Multilingualism was defined based on an adapted version of the Q-Bex questionnaire (De Cat et al., 2022). We measured children's quantitative and spatial language skills. We also assessed their performance in different domains of mathematics, namely numerical competencies, measurement and geometry. In addition, we included measures of general ability, namely general language and spatial skill, and examined their association with children's mathematical language and mathematical abilities. MANCOVA analyses controlling for socio-economic status (SES) indicated that monolingual children outperformed their multilingual peers on mathematical language, measurement and geometry, general language and spatial skill tasks (all p's < .05). The two groups did not differ in their numerical competencies. Turning to the associations between mathematical language and mathematical performance, monolingual children's quantitative and spatial language did not correlate with each other, when controlling for SES and general language. Their quantitative language was related to all three mathematical domains, whereas spatial language related only to their geometry performance. The three mathematical domains were all related to each other in these children. Children's spatial skill related to their measurement scores. For the multilingual children, quantitative and spatial language correlated with each other, and also with their numerical competencies and measurement scores, when controlling for SES and general language. However, the components of mathematical language did not relate to children's geometry scores. Children's mathematical abilities were all correlated with each other, except for their geometry and measurement scores. Finally, spatial skill did not relate to any of the tested variables. These findings indicate that during early childhood multilingual children lag behind their monolingual peers not only in (mathematical) language, but also in mathematical abilities. Importantly, it seems that the associations between components of mathematical language and domains of mathematics differ based on the child's linguistic background. Monolingual children are displaying more of the theoretically expected associations across components of mathematical language, while these are not clearly observed in multilingual children.

# Are babies' cries already language?

**Caroline Nallet[1,2], Gaia Lucarini[1], Irene de la Cruz-Pavía[3,4], Judit Gervain[1,2,5]**

[1]Department of Developmental Psychology and Socialization, University of Padua, Padua, Italy;[2]Padova Neuroscience Center, University of Padua, Padua, Italy;[3]Department of Linguistics and Basque Studies, University of the Basque Country UPV/EHU, Spain;[4]Ikerbasque, Basque Foundation for Science, Spain;[5]Integrative Neuroscience and Cognition Center, CNRS & University of Paris Cité, Paris, France

Newborns and young babies communicate through cries. This has generated the hypothesis that there may be a developmental continuity between cries and our communication system, language. Indeed, a previous study found that French and German babies cry differently, the melody of their cries imitating the melodies of French and German, i.e. the languages their mothers spoke during pregnancy (Mampe et al., 2009), although these results have generated a debate and require further confirmation (Gustafson et al., 2017; Manfredi et al., 2019). In general, it remains controversial whether and, if yes, how cries may be linked with language. In the current study, we tested this hypothesis by investigating whether newborns' cries triggered similar neural processing as speech in adults as well as in newborns, i.e. listeners who themselves can produce cries.

Newborns exposed to French prenatally as well as Italian-speaking adults who do not speak French participated in the study. Adults unfamiliar with French were tested so that, similarly to newborns, they cannot process the linguistic contents of the stimuli. The two groups were tested in the same paradigm and stimuli, and their brain activity was recorded using functional near-infrared spectroscopy (fNIRS), targeting the bilateral fronto-temporo-parietal regions (Figure 1). Participants were exposed to ten blocks of cries recorded from a different set of French newborns as well as spoken French sentences. Cries and sentences were matched in their acoustic properties (intensity and duration). The blocks of cries were composed of ten cries from different French newborns, whereas the blocks of speech were composed of ten sentences produced by different female native speakers of French. No sentence or cry was repeated during the study. The order of presentation of the blocks were intermixed and counter-balanced across infants.

Preliminary results from 24 adults and 23 newborns suggest that newborns have heightened brain responses to cries compared to speech (Figure 2a), while adults show a more pronounced response to speech compared to cries (Figure 2b). Analyses will compare the response to cries vs. speech as well as the two age groups. If confirmed, these results suggest that while cries are not processed identically to speech at either age, their processing may change during development as a result of their changing relevance for communication and production. Infants' heightened responses to cries may be related to the fact that they are able to produce cries and use them for communication.

# PAPER SESSION 4

## METHODS

Friday, 6 January 2023, 17:45-19:05

**Chair:**

Barbara Pomiechowska

### Evidence for the short-term impact of viewing fantastical cartoon content on young children's emerging attention control

**Claire Essex, Teodora Gliga, Tim J. Smith**

[1]Centre for Brain and Cognitive Development, Birkbeck, University of London, UK;[2]University of East Anglia, Norwich, UK;[3]Department of Psychological Sciences, Birkbeck, University of London, UK



Intro/Objective: Despite international recommendations to restrict/limit screen time (e.g., American Academy of Paediatrics, 2016) for children under 4 years, young children are increasingly engaging with screen media (Ofcom, 2019). To understand whether "screen-time" at this age is developmentally appropriate we believe a nuanced approach must be taken to individual pieces of media and their potential demands on viewer cognition, rather than assuming a monolithic "screen-time" effect. For example, multiple empirical studies have shown that children's Executive Functions (EF) are depleted immediately after viewing some types of TV programs but not others (e.g. Lillard & Peterson, 2011; Lillard et al., 2015). These effects have been attributed to general content features such as the presence of fantastical events (e.g. violations of physical laws such as impossible transformations) or formal features such as cut rate. However, neither adequately predicts whether a show will deplete EF. A developmental framework which can formalise and quantify these properties in terms of their demands of children's cognitive resources is needed to isolate and test their short-term impact. In the current study we apply such a framework to the investigation of the impact of fantastical cartoons on children's emerging attention control at 18 months. Fantastical events may be particularly problematic as violations of expectation will require re-assessment of knowledge, which may capture attention to the detriment of other aspects of a scene.

Method: To isolate these events we created matched cartoon content taken from commercially available TV shows (Looney Tunes). The short-term impact on attention control was tested with a gaze contingent infant anti-saccade task. This task indexes exogenous

attention i.e., looks to a salient distractor (Pro-Saccade) and endogenous attention i.e., inhibition of looks to the salient distractor with anticipatory looking to a target (Anti-Saccade). Utilising a within-subjects block design, 36 infants were shown two sets of cartoons interspersed with repeated blocks of the anti-saccade task. Generalised Estimating Equation (GEE) models were used to assess differences in the proportions of saccades (baselined for performance before viewing) between Fantastical and Non-Fantastical content.
Results: When children viewed the non-fantastical cartoon content there was a significant increase in the proportion of anti-saccades with block (p=.006). But when the same children viewed the fantastical cartoon content this increase was absent (p=.35). The proportion of pro-saccades decreased significantly with block when children viewed non-fantastical content (p=.02) but not when they viewed the fantastical content (p=.47).
Conclusions: We found evidence of a short-term impact on children's exogenous and endogenous attention control when viewing fantastical cartoon content but not when the same children viewed non-fantastical content. Only when viewing non-fantastical content did children's ability to inhibit looks to a salient distractor improve with repetition. These findings support existing evidence of short-term effects of viewing fantastical content. Importantly, our design shows it is specifically fantastical events, not other confounding differences between TV shows that leads to poor inhibitory control. Further work is needed to understand the mechanisms which underly these short-term effects and whether effects are sustained in the mid-to-long term.



## Teaching Programming Effects on Preschoolers' Executive Functions

**Maria Julia Hermida[1,2], Andrea Paula Goldin[2,3], Agustín Perez Santangelo[3,4], Sebastián Javier Lipina[5], Fernando Pablo Schapachnik[6]**

[1]Instituto de Educación, Universidad Nacional de Hurlingham, Buenos Aires, Argentina;[2]Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Buenos Aires, Argentina;[3]Laboratorio de Neurociencia, Universidad Torcuato Di Tella, Buenos Aires, Argentina;[4]Instituto de Investigación en Ciencias de la Computación, Universidad de Buenos Aires, Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Pabellón I Ciudad Universitaria, Buenos Aires, Argentina;[5]Unidad de Neurobiología Aplicada (UNA, CEMIC-CONICET), Centro de Educación Médica e Investigación Clínica Norberto Quirno, Buenos Aires, Argentina;[6]Fundación Sadosky, Buenos Aires, Argentina

Teaching programming at schools is worldwide accepted, with most countries moving towards its inclusion in the curriculum. Furthermore, some countries have already started to teach kids how to code even from kindergarten. This educational decision lies in the need for a better understanding of the digital world but also in the potential cognitive

benefits of coding. In fact, programming involves complex cognitive processing, which, in turn, relies on more basic cognitive processes as executive functions. Few controlled trials have analyzed whether the instruction of programming can train executive functions, but to date none of them was conducted in preschoolers.

To analyze this, we conducted a cluster-randomized controlled trial in one medium socio-economic status kindergarten in Argentina. Five-year-old classrooms were assigned to a study group (that received programming instruction with ScratchJr) or a control group (who received art instruction). Activities in both groups included tablets and were carried out by the regular classroom's teachers. All children (n=49) were administered a wide battery of computerized executive functions tests before and after the implementation of training or control activities.

We run a generalized linear mixed model of children's responses to each trial of all tests (10901 trials). The increase from pre to post measures in the odds of making a correct response (odds ratio, OR) in a typical trial for a given task was overall higher for the programming group, compared with the corresponding OR for the control group, but the credibility was lower than expected.

Specifically, we found that (relative to control-group children) programming-group children had: 36% higher OR in the attention task (OR median 1.36, p(rOR > 1) =0.870); 17% higher OR in the inhibitory control and flexibility task (OR median: 1.17, p(rOR > 1) = 0.696); 13% higher OR in the logic reasoning task (OR median: 1.13, p(rOR > 1) = 0.642); finally, no relevant differences were found in planning or working memory.

In sum, our results showed that teaching programming with ScratchJr in preschoolers was associated with higher achievements in attention (with a credibility of 87%), and also suggest improvements in inhibition and, logic reasoning (with lower credibility, i.e., 64 % and 69%). These preliminary results suggest that teaching programming, besides its intrinsic value, can also train cognitive processes crucial for success in school.



## Multimedia and interactive features facilitate knowledge acquisition in primary school children regardless of individual differences in cognitive skills

**Cintia Bali, Kriszta Zsuzsanna Csibi, Viktória Kis, Boróka Gerely, Beatrix Lábadi, András Norbert Zsidó**

University of Pécs, Institute of Psychology, Pécs, Hungary

The wide availability of smartphones and tablets even for children can expand the toolbox of multimedia learning. These touchscreen devices offer new opportunities, such as

embedded interactions accompanied with a various range of multimedia elements (i.e., illustrations, animations, or sound effects). While the efficiency of multimedia elements on knowledge acquisition is well-proven, the literature is not consistent regarding interactive features. A key factor behind the mixed results could be the lack of inclusion of cognitive measures in the experiments. Interactive features might increase cognitive load and distract attention because they are controlled by the user. Therefore, attentional resources might have a great role in processing information through interactive compared to multimedia features. Thus, the aim of our study was to test the efficiency of knowledge acquisition through an electronic storybook application (with embedded multimedia and interactions) while also accounting for individual differences in sustained attention, working memory capacity, and verbal skills.

We investigated the recall performance of primary school children (N = 73; M = 9.5 years) after a storybook exposure. Children were randomly assigned into three groups. In the (1) interactive group, children were introduced to the story through an interactive storybook application, that they could use on their own. In the (2) multimedia group, children watched a screen video of the application with the same visuals and narration. Lastly, in the (3) control group, children saw static illustrations from the app accompanied with the narration of the experimenter. Immediately after the exposure, children were asked to answer 14 questions related to the story. All answers were rated by independent scorers as incorrect (0 point), partly correct (1 point), or correct (2 points). Additionally, we measured working memory capacity, selective and sustained attention, and verbal skills of the children, while teachers rated their behaviour using the ADHD Rating Scale-IV (for the descriptive data see Table 1). The storybook contained a moderate number of story relevant multimedia and interactive features.

Our results suggest that electronic storybooks enhanced with multimedia and interactive features improve recall performance of primary school children (see Figure 1). This effect is independent from working memory capacity, selective and sustained attention, and verbal skills of the children. However, children with worse attentional and verbal performance recalled less information in all three groups.

In conclusion, electronic storybooks with embedded multimedia and interactive features have the potential to facilitate information processing and general knowledge acquisition in primary school children. Further, it seems plausible that use of a few and relevant multimedia and interactive features will not interfere with information processing even for those with less attentional resources and worse verbal skills. Future studies are needed to explore the exact relationship between recall performance and the number of multimedia and interactive features.

## Kids corroborate: A validation study of various measures of interest in young children

**Rajalakshmi Madhavan[1,2], Ben Malem[1], Lena Ackermann[3,2], Nivedita Mani[1,2]**

[1]Psychology of Language Group, University of Göttingen, Göttingen, Germany;[2]Leibniz ScienceCampus Primate Cognition, Göttingen, Germany;[3]Donders Institute for Brain, Cognition and Behaviour, Radbound University, Nijmegen, The Netherlands



Studies have shown that children actively steer their learning progress, by pointing and vocalising to extract information they are interested in from conversation partners, and learning and retaining such information better (Mani & Ackermann, 2018). Children's interests in particular topics and objects have typically been indexed using measures such as children's touchscreen responses in active choice tasks, their attention to particular objects in looking time tasks, parental reports and more recently, physiological responses such as pupillary arousal (Kang et al., 2009; Partridge et al., 2015; Ackermann et al., 2020). The aim of the study is to examine the association between previously reported measures of children's interests, with regard to children's interest in natural object categories as indexed by (1) parents' approximation of children's category knowledge, (2) parents' estimation of their child's interest in the categories, (3) extrinsic (overt choices in a task), (4) intrinsic (looking time toward objects) (5) and physiological (pupil dilation) responses to objects from different categories. We recruited 81 2-3-year-old monolingual German children. Children completed two tasks: (a) a Pupillometry and looking time task, where they were presented with images from a range of defined categories; (b) A sticker-choice task, where they were asked to choose between two sticker-images from two different categories belonging to the range of categories assessed in the previous task. In addition, prior to the study taking place, parents completed two questionnaires aimed to estimate (i) their child's interests and (ii) vocabulary knowledge in the categories presented. Our analyses showed that (1)(2) parents' estimations of children's categorical interests are closely associated with parents' knowledge of children's category knowledge; (2)(3) we did not find a significant relationship between children's categorical preferences measured by overt choices and parents' estimation of children's interests; although, upon closer inspection, there is a possibility of such a relationship existing. (3)(4)(5) we did not find any significant association between pupillary dilation or looking time and parent estimations of interests; only, (4)(5) a significant relationship between pupillary dilation and looking time in children. These results suggest that parent and children measures are closely associated within themselves, but not with one another; with the exception of children's overt behaviour being marginally associated with parent measure. This proposes that parents

are consistent with their reporting of their children's interests and category knowledge, and they associate their children's selective interests with the quantity of words their children know in different categories. The possible relationship between children's overt categorical preferences and parent reports of interests hint that parents may estimate their children's interest through observation of children's behaviour during daily interactions and activities. With this study, we examined and validated the degree of associations between various measures of interest in early childhood, integrating physiological, behavioural, and parental responses as to what constitutes interest in young children. Thereby, we establish dependable methods to investigate how interest affects learning during childhood.

# PAPER SESSION 5

## METACOGNITION

Saturday, 7 January 2023, 11:15-12:15

**Chair:**
Maria Mavridaki

### Representing possibilities under Epistemic and Physical Uncertainty

**Lydia Paulin Schidelko[1], Marina Proft[1], Marlene Meyer[1], Leonie Baumann[1], Jan M. Engelmann[2], Hannes Rakoczy[1]**

[1]University of Göttingen, Germany;[2]University of California, Berkeley



Influential recent accounts claim that children acquire concepts of epistemic and other kinds of modality relatively late, not until the age of four or older (Leahy & Carey, 2020; Redshaw & Suddendorf, 2020). The main empirical support for these claims comes from studies in which children are faced with an uncertain situation, for example, in which of three cups two stickers are hidden (Mody & Carey, 2016) or which of two objects is in a given box (Kloo et al., 2017). Across tasks, children consistently fail to appreciate their uncertainty about alternative possibilities or to choose a certain over an uncertain option. In light of contrasting results from possibility understanding in infancy (e.g., Cesana-Arlotti et al., 2018), two pressing research questions arise. First, do these results of preschooler's failure present false negatives? Second, what are the cognitive foundations of modal thought? In five studies, we aim to investigate whether these results of late developing modal reasoning persist in adapted measures and optimal test settings and compare children's performance in modal reasoning tasks to their developing meta-representational abilities. In Study 1, three- to five-year-old children (N= 90) were tested in their ability to hold modality representations in a simplified version of the forked tube task (physical uncertainty; Redshaw & Suddendorf, 2016) and a partial exposure task (epistemic uncertainty; Kloo et al., 2017). We compared children's performance in these modified modality measures with their developing first- and second-order false belief reasoning as a measure of meta-representational thinking (Wimmer & Perner, 1983). In Study 2 (N = 100, age: 3-6 years) and Study 3 (in data collection, final sample N = 90; age: 3-5 years) we test for children's possibility representations under epistemic and physical uncertainty in a minimal contrast paradigm. To this end, children are asked to prepare for an event that happened but they

are ignorant about (epistemic uncertainty) or a future event (physical uncertainty) in a slides task (adapted from Beck et al., 2006; Robinson et al., 2006) and in a version of a forked tube task (Redshaw & Suddendorf, 2016). Again, children's performance in these tasks is compared with their developing first- and second-order false belief reasoning. In Study 4 (N = 66; 3- and 5-year-olds) and Study 5 (in data collection, final sample N = 60, age: 3 years) we administer versions of a partial exposure task (epistemic uncertainty; Rohwer et al., 2012; Kloo et al., 2017) and a three-cups task (epistemic uncertainty; Mody & Carey, 2016) in a social, cooperative test situation. A cooperative and communicative context, in which children have to give reasons and justifications towards others, might enhance young children's metacognitive insights and their modal reasoning abilities under epistemic uncertainty.

The results of these studies will be discussed with regard to (1) accounts claiming modal thought in infancy (e.g., Cesana-Arlotti et al., 2018), contrasting (2) accounts claiming a late development of modal thought (Leahy & Carey, 2020) and (3) accounts claiming meta-representational foundation of modal reasoning (e.g., Redshaw & Suddendorf, 2020).



## Developmental Changes in Children's Training Strategies

**Daniil Serko[1,2], Julia Leonard[3], Azzurra Ruggeri[1,2,4]**

[1]MPRG iSearch, Max Planck Institute for Human Development;[2]School of Social Sciences and Technology, Technical University Munich;[3]Department of Psychology, Yale University;[4]Department of Cognitive Science, Central European University, Vienna, Austria

Effective practice is key to learning. Yet, it is unclear whether young children make effective training choices. Across three studies, we investigate 2.5- to 8-year-old children's (n=243) ability to tailor their training strategies to optimize outcomes.

In Study 1 (n = 146), we implemented a within-subjects design. Children played one easy and one difficult game, and had to choose which game they wanted to practice. Crucially, before they chose, we told them they would eventually be tested either on the game of their choice (Choice condition) or a randomly chosen game (Random condition). We expected children to train the easy game in the Choice condition (and choose it at test), and to train the difficult game in the Random condition.

Contrary to our hypotheses, we found that condition did not predict children's training choices. However, older children were more likely to make effective and adaptive training choices than younger children, who overwhelmingly selected to practice the easy game in both conditions. Moreover, we found that in 18% of the rounds, children in the Choice

condition practiced the difficult game, but chose to be tested on the easy game and obtained the maximum score. This sophisticated choice pattern allowed them to enjoy the game more, by learning something new, without compromising their performance.
To make the patter of results more evident, in Study 2 (n = 97) we implemented a similar design, with one crucial difference: We replaced the Choice condition with a Difficult and an Easy condition, where children were explicitly told they would be tested on the difficult or easy game, respectively. We found that the interaction of age and condition significantly predicted training choices, revealing that children's training choices become more effective and adaptive with age (see Fig. 2). Taken together, the results from Study 1 and 2 suggest that younger children may need more explicit guidance about how to best allocate their training efforts to compensate for their weaknesses versus boosting their strengths.
In Study 3 (data collection ongoing), we developed a simplified paradigm to test the same question in a population of 2- to 4-year-olds. Children are familiarized with cuboid blocks, easy to stack, and oddly-shaped blocks, difficult to stack, as they are harder to balance onto each other. Just like in Study 2, we then tell children that, eventually, they will have to build a tower out of the easy blocks (Easy condition), the difficult blocks (Difficult condition), or hidden blocks, of which they cannot see the shape (Random condition).
Children then choose their practice blocks. We predict that young children will show effective training choices.



## The effects of disagreement on young children's overconfidence and information search

**Antonia Langenhoff, Mahesh Srinivasan, Jan Engelmann**
University of California, Berkeley, USA

Young children are often overconfident: they overestimate their knowledge (e.g., Hagá & Olson, 2017). This can have problematic consequences, because somebody who is not aware of gaps in their knowledge may be less likely to seek new information, and thus less likely to learn (e.g., Dunlosky & Rawson, 2012). Across two experiments, we investigated whether disagreeing (versus agreeing) with a social partner can help children develop a more realistic view of their epistemic limitations and motivate them to search for information.
In Study 1, 4- to 6-year-olds (N = 68) determined, together with a confederate, which toys in a set were "blickets" after being exposed to ambiguous evidence. We measured children's confidence regarding which toys were blickets before (t1) and after (t2) the confederate either disagreed or agreed with their belief. We also assessed how much time children

spent searching for additional information about which toys were blickets after the confederate left. We found that children in the disagreement condition were significantly less confident in their initial belief at t2 ($p = .03$), and searched marginally longer for additional information (n.s., $p = .13$), compared to children in the agreement condition.

In Study 2, we investigated whether disagreeing with an expert would lead to stronger reductions in overconfidence. At the beginning of the study, the experimenter introduced the confederate as a "blicket expert". Then, children ($N = 68$, 4 – 6 years) and the confederate were presented with the same task as in Study 1. Analyses revealed a three-way interaction of study, condition, and age on children's confidence judgments: in Study 2, disagreement with an expert led to stronger reductions in confidence than in Study 1, particularly in older children ($p = .04$). Moreover, children in the disagreement condition of Study 2 searched significantly longer for additional information than children in the agreement condition ($p = .03$).

Together, our findings are among the first to show that children can reduce their overconfidence, and they provide insight into one specific way in which they can do so: through social disagreement. More broadly, our findings suggest that under the right circumstances, disagreement can serve as an important social mechanism enabling people to make more sound and intellectually humble judgments.

# SYMPOSIUM 3

## LEARNING HOW TO EXPLORE: THE DEVELOPMENTAL MECHANISMS OF INFORMATION SEEKING

Saturday, 7 January 2023, 13:15-14:30

**Organizers/Chairs:**

Francesco Poli, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, the Netherlands
Tommaso Ghilardi, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, the Netherlands

**Speakers:**

Tommaso Ghilardi, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, the Netherlands
Laura Ziemann, Max Planck Institute for Human Development
Olivier Mascaro, Integrative Neuroscience and Cognition Center, CNRS/Univ. Paris Cité
Martina de Eccher, University of Göttingen, Göttingen, Germany



As humans, we explore the environment actively and strategically, and our efficiency is superior to any other form of natural (Rosati, 2017) or artificial (Oudeyer, 2017) intelligence. This ability is crucial to acquire information in an effective way, and to use it to further shape the world around us. However, how and when the ability to optimally explore the environment emerges is still unknown. Recent evidence shows that infants attend more to informative stimuli (Poli et al., 2020), preferentially explore stimuli that were behaving in unexpected ways (Perez & Feigenson, 2022), and when in need for information, they pay more attention to adults that are more knowledgeable (Bazhydai, Westermann, & Parise, 2020). This indicates that a sensitivity to information is present from early in life. Currently, we do not know how infants actively structure their information search, and how the rudimentary abilities found in the first year of life develop into the strategic exploratory behaviours displayed by older children and adults.

This symposium introduces four studies that investigate exploratory behaviours in a variety of new paradigms and methodologies across different developmental stages. The goal is to elucidate the cognitive mechanisms underlying information seeking, and how they change across the first years of life.

The first talk focuses on how 8-month-old infants learn to attribute value to information. Employing pupillometric and fNIRS data in conjunction with a novel experimental paradigm, this talk elucidates how infants extract information from novel environments, and

the unique way in which infants process informative stimuli.
Starting from the ability to detect information around them, children later develop the ability to explore the environment actively and strategically, adapting their exploratory patterns to the specific problems they are trying to solve. The second talk investigates how this ability emerges between 24 and 36 months of age using a novel paradigm that elegantly minimizes the need for cognitive resources and verbal instructions.
The third talk turns to infants' processing of third-party information seeking. It leverages infants' sensitivity to other's knowledge to investigate 14- and 18-month-olds' interpretation of information requests. It argues that, by this age, infants appropriately assume that people ask questions to learn novel information.
Even refined exploratory abilities might come with little meta-cognitive awareness. The fourth talk revolves around this issue, employing two novel cross-situational word learning tasks to address whether 5-year-old children and adults are aware of what they know and what they do not know, and whether they actively solicit information about things they do not know about.
Together, these talks present new paradigms in which the cognitive bases of infant information seeking can be studied, and they advance our understanding of the developmental mechanisms underlying exploratory behaviour.



## Infants learn where to find information: an fNIRS-pupillometry study

**Tommaso Ghilardi[1], Francesco Poli[1], Sabine Hunnius[1], Denis Mareschal[2]**
[1]Donders Institute for Brain, Cognition and Behaviour, Nijmegen, the Netherlands;[2]Birkbeck University of London, London, UK

Learning from the environment is challenging, as it requires extracting relevant information from a huge amount of ever-incoming sensory data. This process is especially important during the first months of life, when infants know little about the environment, and yet they are required to learn the most. Although much is known about infants' sophisticated learning abilities (Poli et al., 2020), we know little about how they assess the informativity of incoming stimuli. This ability is crucial for optimal learning, as it allows to create expectations on where information can be found, and invest cognitive resources accordingly.
In this study, we monitored pupil dilation with an eye-tracker and the activity of the prefrontal cortex with fNIRS to understand how infants build expectations about stimulus informativity over time. We presented 8-month-old infants with multiple trials in which different shapes could either predict the location of a subsequent target stimulus (in-

formative cues) or move randomly (uninformative cues). The cues could have a smooth or pointy shape, and this feature indicated whether they are informative or uninformative of the target location.
Preliminary results (N=19) show that infants learn to discriminate the stimuli depending on their informativity. Pupil dilation, which correlates with noradrenergic activity, is greater when stimuli are novel or uninformative, but it reduces for informative ones. We are currently analyzing fNIRS data, where we expect to find higher activity in infants' prefrontal cortex when stimuli are more informative. These findings are crucial to understand infants' ability to extract and expect information from the environment.

## Toddlers adapt their exploratory strategies to the information structure of the task



**Laura Ziemann, Azzurra Ruggeri**
Max Planck Institute for Human Development, Germany

We investigated whether toddlers are ecological active learners, able to select those active learning strategies that are most informative depending on the task at hand.
Across two studies, 2-3-year-olds (N=100) are shown a ball rolling down through a transparent marble run, which has four exits at the end. Children are familiarized with two structures of the marble run: In the Uniform condition, all the passages are open, so that the ball is equally likely to fall from any of the four exits. In the Skewed condition, only one passage is open, so that the ball always falls from the same exit. In the Search version of the task (Study 1), the four exits correspond to four boxes. Children at test are asked to close their eyes during a marble run, and then choose which of two exploratory actions to perform to find in which box the ball has fallen: reach inside one of the boxes or look over the boxes, by removing the lid that is covering them. In the Catch version of the task (Study 2), children have to choose which of two boxes to use to catch the ball running through the marble run: the Small box covers only one exit, whereas the Large box covers three exits. Preliminary results (N= 45) suggest that children tend to choose the right action (Look or Open) and the correct box (Small or Big) depending on the condition, suggesting that toddlers tailor successfully their exploratory actions to the different likelihood distributions.

## Infants recognize the information-seeking function of interrogative sentences

**Olivier Mascaro, Adeline Depierreux, Viviane Huet, Emma Roumat**
Integrative Neuroscience and Cognition Center, CNRS/Univ. Paris Cité, France

Questions play a central role in human learning and communication. They allow learners to express their specific informational needs and to figure out what others want to learn. This study examined infants' ability to understand questions, defined as interrogative sentences used to convey a request for information.
Missing a piece of information is a necessary precondition for seeking it out. In accordance with this key property of information search, adults and preschoolers disambiguate questions by assuming that people request pieces of information that they lack (Aguirre et al., 2022). Here, we study the early ontogenetic emergence of this ability, and test whether infants are sensitive to the information-seeking function of interrogative sentences.
Fourteen- and eighteen-month-old infants (n = 28 per age group) were tested in a two alternatives forced-choice eye-tracking paradigm. Infants viewed videos in which a speaker asked a question whose meaning was ambiguous. The question could refer to the location of one of two objects. Yet, the ambiguity could be resolved by tracking the speaker's state of knowledge, because the location of only one of the objects was unknown to the speaker. When infants needed to disambiguate the question, they looked longer at the object whose location was unknown, rather than known, to the speaker. Thus, by 14 months of age, infants are sensitive to the information request function of interrogative sentences. Moreover, infants' interpretation of questions is guided by the foundational assumption that people search for information that is new, rather than already known.



## Active learning and information-seeking behaviour in children

**Martina de Eccher, Nivedita Mani**
University of Göttingen, Göttingen, Germany

How do children select information they want to learn about? Active learning, where learners can actively sample the environment, seems to improve learning (Markant et al., 2016). This advantage might arise from the opportunity to examine materials relevant to them. Across two studies, we examined whether 5-year-olds use awareness of their knowledge of newly learned object-label associations to actively look for information that

will fill knowledge gaps, and whether this information-seeking strategy improves learning. In a first study, participants completed a cross-situational word-learning task where they saw images of novel objects while hearing their novel labels. After training, learners indicated their confidence in knowing the labels of each object. Next, they could sample objects whose labels they wanted to hear again. Participants were then tested on their label-object association learning. In a follow-up study (to be finished by December 2022), we compare active and passive learning by either providing the possibility to choose which objects to sample or by presenting objects randomly.

Results from the first study show that 5-year-olds do not seem to have an information-seeking strategy based on their confidence in what they learned: they were equally likely to sample objects they reported having high and low confidence in. Even though accuracy was higher on sampled objects only when they were rated low confidence, children who sampled more low confidence objects did not perform better at test. Together, these studies examine how children gather new information and whether the opportunity to actively sample information is beneficial for learning.

# PAPER SESSION 6

## THEORY OF MIND

Saturday, 7 January 2023, 16:30-17:30

**Chair:**
Laura Schlingloff-Nemecz

### Would you do that if you knew? Children understand how ignorance and partial knowledge give rise to behavior

**Rosie Aboody[1,2], Julianna Lu[3], Caiqin Zhou[4], Madison Flowers[5], Stephanie Denison[3], Julian Jara-Ettinger[6]**

[1]Harvard University, Cambridge, USA;[2]MIT, Cambridge, USA;[3]University of Waterloo, Waterloo, Canada;[4]Brown University, Providence, USA;[5]Georgetown University, Washington DC, USA;[6]Yale University, New Haven, USA



To make sense of others' behavior, we must understand how different degrees of knowledge affect people's actions. While even preschoolers can successfully reason about the behavior of knowledgeable agents (Pillow, 1989), children at this age appear to have a poor grasp of how ignorance drives behavior (Friedman & Petrashek, 2009; Ruffman, 1996). Leveraging a computational lens, we propose that children's poor understanding of how ignorance relates to action could be caused by two different components: 1) A poor understanding of how ignorant agents rely on past experiences to make reasonable guesses; and 2) A poor understanding of how ignorant agents might act successfully by luck. Across five experiments, we investigate the development of these capacities.

Investigating component 1, Experiments 1-3 (N=264) test whether four- to six-year-olds expect ignorant or partially-informed agents to act according to their prior experiences; see Figure 1a. Experiment 1 tests whether children predict agents will rely on past experiences to solve a related problem: a character learned which of two buttons activated a toy, and was asked to activate a new visually-identical toy. Children of all ages predicted that the agent would make an informed guess, pressing the same button he'd seen activate the first toy. Experiments 2-3 test whether children can use this expectation to infer that an agent who acts inconsistently with their past experience likely has some additional knowledge that justifies the behavior. Two characters learned which button activated a toy. When activating a new visually-identical toy, one relied on his experience with the

first toy; the other pressed a button which had been inert on the first toy. In Experiment 2, both succeeded in activating the toys; in Experiment 3, both failed. Six-year-olds inferred that the agent who pressed the previously-inert button had either known all (Experiment 2) or more (Experiment 3) about the toys, explaining why he did not rely solely on what he had learned about the first toy.

Investigating component 2, Experiments 4-5 (N=180) test whether preschoolers can estimate an agent's probability of a chance success given ignorance, attributing knowledge only when the odds of a random success are low; see Figure 1b. Participants learned about a task with a low probability of random success (25%), and one where success was assured (100%). By age six (but not before), children preferentially assigned the task with a low probability of random success to gauge an agent's epistemic state (Experiment 4) and inferred prior knowledge from successful completion of this task (Experiment 5).

Together, our findings suggest that children's poor ignorance-reasoning reflects a mixture of capacities that are developing over time. While children have an early understanding that ignorant agents rely on prior knowledge, they require additional time to learn how to make inferences upon this basis, and estimate an agent's probability of success given different epistemic states. By breaking down the components of ignorance-reasoning, we open new avenues for future work to investigate how epistemic reasoning develops.



## The role of different tracked experiences in children's false-belief understanding

**Qianhui Ni[1], Bella Fascendini[1], Lisa Miao[1], Rachel Henry[1], Henrike Moll[1]**

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Young children can track other people's experiences, which helps with their subsequent reasoning about others' beliefs and actions (Perner, Rendl, & Garnham, 2007). Perner et al. (2007, 2010) argued that during the encounter, the information about the agent, the object they interact with, and the relations between the agent and the object are stored in a piece of "Experiential Record". The current study investigated how children register different experiential records from witnessing others' direct or indirect interactions with objects and how the effects of these experiential records may vary in false-belief understanding. In Experiment 1, 30 3-year-olds watched four puppet show stories in which a puppet ate some food items from a container (Perceptual Condition) or was told that some items were in a container (Testimonial Condition). During the puppet's absence, the rest of the food items in the container were replaced with new, inedible objects. After the puppet returned, we

recorded and analyzed children's suspenseful expressions (e.g., lip bite, frown eyebrows, smirk) as the puppet slowly approached the container. If children understand that the puppet held a false belief about what was in the container, tension builds up in the story, thus they are expected to show more expressions. Our results showed that 3-year-olds showed significantly more expression in the Perceptual Condition, $p < .01$, indicating that the experiential record formed from a perceptual encounter may benefit belief understanding more than an indirect one. The ongoing Experiment 2 with another 78 3-year-olds further explores if the perceptual experiential record has to come from children themselves or from the agent. Taken together, we found that 3-year-olds need to rely on the experiential record built from their own eyewitness in belief understanding. This study contributes to our knowledge of the scope and limits of preschoolers' theory of mind.

## Language Supports Toddlers' Understanding of Others' Experiences

**Brandon Woo[1,2], Mia Taylor[1], Adrian Tsang[1], Sanghee Song[1], Elizabeth Spelke[1,2]**

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People are often challenged to track their social partners' distinct perspectives: what is upright vs. inverted, on one's left vs. right., etc. The notion that people experience the same objects differently is foundational to human communication. Evidence from nonverbal tasks reveals that infants appreciate differences between their own and others' perceptual access to objects, but no study has revealed whether they implicitly understand that they and others, with equal perceptual access to objects, may experience objects differently. We tested for this ability in 14- to 15-month-old toddlers.

In Experiment 1 ($n = 20$), toddlers were familiarized to events in which an actor sat on the side of a room, facing the room's center, where there were two pictures (Fig. 1A, 1B). These pictures looked like two different animals, depending on their orientation and one's perspective: The picture that looked like a rabbit to the actor looked like a duck to the toddler, and the picture that looked like a duck to the actor looked like a rabbit to the toddler. In familiarization, the actor reached consistently for pictures of a certain orientation (e.g., a rabbit to him). From such behavior, toddlers could infer that the actor has a goal to act on a particular animal, but would toddlers represent the goal from the actor's or the toddler's perspective? At test, the actor moved so that his and the toddler's perspectives aligned. In alternating test trials, he reached for pictures of the same orientation relative to familiarization, to either him or the toddler. Toddlers looked longer when the actor reached for pictures of the same orientation to himself. Thus, the toddlers appeared egocentric:

They prioritized their own experiences, expecting the actor to act on pictures in the same orientation to themselves. In Experiment 2 (n = 37), we replicated this finding.

In Experiments 1-2, the actor never spoke. In everyday interactions, however, people convey their experiences through language. Thus, in Experiment 3 (n = 48), we probed whether informative language supports toddlers' understanding of others' experiences. Here, the actor initially sat at the front of the room, such that his perspective on two duck-rabbit pictures aligned with the toddler's (Fig. 1C). In the informative condition, the actor conveyed his experiences ("I see a duck/bunny"), and said "I want the duck/bunny" before reaching for the corresponding picture. The use of such nouns may support toddlers' understanding of kinds (Dewar & Xu, 2007). In the uninformative condition, the actor instead used pronouns ("I see one/something here"). In both conditions, at test, the actor moved to the room's side, where his perspective now differed from the toddler's. In alternating test trials, involving no speech, he reached for pictures of the same orientation relative to familiarization, to either him or the toddler. Only the toddlers in the informative condition looked longer when the actor reached for pictures of the same orientation to the toddler, rather than to the actor. In sum, toddlers struggle to understand others' experiences of pictures, and language may support this understanding.

# PAPER SESSION 7

## CAUSAL REASONING

Saturday, 7 January 2023, 17:45-18:25

**Chair:**
Denis Tatone

### Causal perception in Papio papio: Discrimination and categorisation of Michottean launches

**Floor Meewis[1,2], Joël Fagot[1,2], Nicolas Claidière[1,2], Isabelle Dautriche[1,2]**

[1]Aix Marseille Univ, CNRS, LPC, Marseille, France;[2]Station de Primatologie-Celphedia, CNRS UAR846, Rousset, France



In humans, simple 2D visual displays of geometric shapes can evoke high-level percepts such as causality. In particular, when object A moves into a stationary object B, and if B starts moving as soon as A stops (a launching event), people infer that A caused B to move (Michotte, 1963). A rich body of literature since Michotte's seminal work reveals that introducing a temporal or spatial delay between the movements of the two objects disrupts the impression of causality altogether (review: Scholl & Tremoulet, 2000). This seemingly higher-order cognitive capacity to discriminate between causal and non-causal events appears to be largely perceptual in nature (Moors et al., 2017) and develops early and preverbally in infants. Notably, habituation studies have shown that from 6 months old onwards, infants view causal launching events as categorically distinct from similar non-causal events which include a spatial or temporal delay between the two objects (Oakes, 1994; Cohen & Amsel, 1998).

In this study we tested the evolutionary origins of causal perception and examined whether non-human primates perceive launching events in terms of causality. We trained Guinea baboons (Papio papio) to sort 2D Michottean launching animations in a touch screen task using a match-to-sample paradigm (Figure 1). In the causal vs. non-causal condition, baboons were trained to discriminate causal launching animations from three non-causal animations featuring either a spatial delay, a temporal delay or both a spatial and temporal delay. In the control condition, baboons were trained to discriminate the spatial+temporal delay animation from the three others. If baboons solely base their discrimination on low-level spatiotemporal characteristics, they should take as much time to learn either

condition. Indeed, both the temporal delay and the spatial delay events are equally different from the spatial+temporal delay event as from the the direct launching event in terms of their perceptual features (presence/absence of a delay, see Cohen & Amsel, 1998). In contrast, if, similarly to humans, baboons are responding based on causality, they should find the causal vs. non-causal division easier to learn than the control division. The two conditions were implemented in different order and using different stimuli sets such that all participants were tested in both conditions. Contrary to humans, baboons (n=6) did not learn the causal vs. non-causal condition faster than the control condition (Figure 2). Further post-hoc tests revealed that baboons in both conditions generalised their trained discrimination to novel videos, showing that they had not merely memorised the specific training videos but picked out the distinctive spatiotemporal features (the presence/absence of a delay) that characterised those events.

In our study, we showed that baboons are able to learn to correctly classify videos that, for humans, belong to causal and non-causal categories. However, there was no learning advantage for the division based on causality, which revealed that, in contrast to humans, baboons make use of lower-level perceptual features for the classification. Therefore, it appears that the perception of causality does not manifest itself as automatically and irresistibly in baboons as in humans.



## "It Depends": How Children Reason about Stable and Unstable Causes

**Ny Vasil[1,2], Mei Murphy[2], Samhita Katteri[2], Tania Lombrozo[3], Alison Gopnik[2]**

[1]California State University East Bay;[2]University of California Berkeley;[3]Princeton University

Do rocks sink or float in water? The answer is "it depends": rocks sink or float depending on their shape and the salinity of the water. Such dependencies on context are common in physical, biological and social causal systems, and need to be mastered by successful learners. Interestingly, prior work showed that adults penalize causal relationships that depend on context (unstable relationships), and instead favor causal relationships that are stable (i.e., hold robustly across background contexts) in their actions and causal/explanatory generalizations (Vasilyeva et al., 2018). If such preference persists through development, it could serve as a useful constraint on causal hypotheses, helping solve a fundamental challenge in causal learning – but at the expense of making learning of complex systems particularly challenging.

Here we explore the developmental trajectory of the preference for causal stability. In two studies with 4-7-year-olds (N = 198) we investigate how children respond to causal (in)sta-

bility when they explain observations and design interventions in novel contexts. In Study 1, children reasoned about stable and unstable probabilistic causes in a space-themed animated story about aliens. Different aliens represented stable or unstable causes that produced an effect (a spark) with either the same or variable probability across different contexts (planets) (see Figure 1). In Study 2, children were presented with real-life novel objects: toys that light up with same or variable probability when placed on different "machines", or contexts (see Figure 2). In both studies, we measured children's preference for stable vs. unstable causes (aliens) in two key tasks: explanation (a backward-looking judgment; e.g. deciding which alien produced an outcome in an ambiguous event) and intervention (a forward-looking judgment required in action planning; e.g. selecting whether to act on a stable or unstable cause, i.e. deciding to send either a stable or an unstable alien to generate a spark on a novel planet, see Figure 3). Additionally, we assessed whether children's perception of average causal strength was biased: whether they thought a stable or an unstable cause was overall stronger, when in fact they were equally strong.

We report a potential developmental shift in reliance on stability to guide action: surprisingly, the direction of shift is from intervening on stable causes to unstable causes. Additionally, we find that older children's reports of mean causal strength are biased: they incorrectly claim that the unstable cause is stronger; younger children are inaccurate but not biased. Finally, after learning that the two causes are equally strong, younger children's preferences switch from stability to instability. While we have documented a novel relationship between perceptions of causal strength and (in)stability preferences, the direction of influence remains unclear.

In sum, we report a developmental shift in reliance on causal stability, highlight the important role of perceived average causal strength in determining children's causal preferences, and discuss the implications of our findings for theories of early causal learning and understanding of complex systems across development. To our knowledge, this is the first study exploring the role of stability in children's causal reasoning

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# POSTER SESSION A: THURSDAY

## PA-001 The relationship between executive functions and syntactic complexity in personal and fictional narratives

Şule Yüsra Bozkuş, Hale Ögel-Balaban
Bahçeşehir University, Istanbul, Turkey

The organization of a narrative is reflected through its syntactic structures which are means to express the coherent, causal, temporal and logical order of the narrated events. The formation of syntactically complex clauses in a narrative has been claimed to be related to the development of executive functions. Planning the syntactic structures, inhibiting irrelevant lexical and grammatical representations, forming and coordinating clauses on the basis of grammatical rules, combining and switching between them require working memory, inhibition, and shifting abilities (Drijbooms et al., 2015; Drijbooms et al., 2017; Friend & Bates, 2014; Kellogg et al., 2013; Mozeiko et al., 2011; Ögel Balaban & Hohenberger, 2020). In the literature there are only a few studies examining the relationship between executive functions and syntactic complexity and they have mostly focused on fictional narratives. The production of personal and fictional narratives involves different cognitive processes (Hudson & Shapiro, 1991). Personal narratives require episodic memory and include real world events and the characters who are mostly people the narrator knows (Longobardi et al., 2014; Mills et al., 2013; Westby & Culatta, 2016). On the other hand, fictional narratives require semantic memory and include imaginary events and characters created by the narrator (Allen et al., 1994; Mills et al., 2013; Schank, 1990). Considering the different demands of the two types of narratives, the main aim of the present study was to examine the relationship between executive functions, particularly inhibition, shifting and working memory; and syntactic complexity in personal and fictional narratives. Forty 4- and 5-years-old Turkish-speaking children participated in the Turkish Expressive and Receptive Language Test (TIFALDI) measuring receptive language, the Day/Night Task (DNT) measuring inhibition, the Dimensional Change Card Sorting Task (DCCST) measuring shifting, and the Turkish Non-Word Repetition Task (TR-NWR) measuring working memory. To elicit personal narratives, participants were presented with a sample of events (e.g. going to the school, going to the park, and going to the grandparents' home) and asked to tell what happened during a similar event. The wordless picture book Frog, Where Are You? (Mayer, 1969) was used to elicit fictional narratives. Syntactic complexity was operationalized as the ratio of the C-units (defined as the main clause with its subordinate clauses) including Turkish subordinate clauses over the total number of C-units in each narrative.

The syntactic complexity level in personal and fictional narratives was not found to increase with age. Performance on expressive language and inhibition tasks was found to increase with age. There was no relationship between executive functions and syntactic complexity in personal and fictional narratives.

The findings were discussed in terms of their implications for narrative development considering the requirements and demands of personal and fictional narratives, the syntactic structures in Turkish, and the limitations of the study.

## PA-002 Motor Executive Cognitive Interaction in Dyslexia

Rebecca Gordon, Jennifer Spicer, James Smith-Spark

University College London, London, United Kingdom

Cognitive difficulties are well documented in developmental dyslexia but they present a challenge to dyslexia theory. In this paper, the Model of the Control of Action is proposed as a theoretical explanation of how and why deficits in both automaticity and executive abilities are apparent in the cognitive profiles of dyslexia and how these deficits might relate to literacy difficulties. The neuro-anatomical underpinnings of automaticity and executive abilities are then discussed in relation to the understanding of dyslexia. The reviewed evidence suggests that dyslexia theory should consider an interaction between procedural learned behaviour (automaticity) and higher-order (executive) abilities. The capacity to handle environmental interference, develop and engage adaptive strategies accordingly, and plan actions all require interactions between the cerebellum and the prefrontal cortex (PFC). Difficulties in these areas might explain both impairments in the cumulative development of literacy skills in childhood and general task management in everyday life in adulthood. A pilot study of a new task designed to measure this cerebellar–PFC interaction is presented. Findings might allow early identification of future literacy difficulties, allowing implementation of timely interventions and reasonable adjustments.

## PA-003 The role of attention in spatial-temporal cognition and causal reasoning in science

Andrew Tolmie[1,2], Tom Northrop[1,3], Darja Berga[1,4]

[1]University of London Centre for Educational Neuroscience, London, UK; [2]UCL Institute of Education, London, UK; [3]University of East London, London, UK; [4]Birkbeck, University of London, London, UK

It is evident that a central aspect of scientific thinking is causal reasoning, whereby operative factors and mechanisms are perceived and inferred through observations, providing the basis for theoretical constructs. Developing this foundational ability enables young people to develop their skills through experimentation at later stages (Piaget, 1972; Kuhn, 2011). Our research shows that the capacity to infer mechanisms is particularly crucial and explains significant variance in children's performance on TIMMS Grade 4 science items (Dündar-Coecke & Tolmie, 2019a; Dündar-Coecke & Tolmie, in preparation). Children's causal reasoning capacity is highly variable across the primary years. Despite current interest in spatial cognition as applied to science more generally (Uttal et al., 2013), the source of this variation seems to originate substantially not from that but from children's ability to extract spatial-temporal information from observed phenomena, which it is argued allows them to mentally capture the underlying dynamic process that leads from cause to effect. Over two large samples, where 5 to 11 year old children were tested individually, we found capacity for spatial-temporal analysis uniquely explained 15.2% of variance in children's causal inference over and above verbal, generic nonverbal, and spatial tasks, and was a necessary precursor for identifying mechanisms

(Dündar-Coecke et al., accepted). Despite this evidence suggesting that spatial-temporal analysis provides a foundation for the development of causal reasoning, it therefore remains unclear 1) how precisely spatial-temporal analysis should be fractionated, 2) which sub-components of this complex skill are particularly relevant to scientific development, and 3) the precise route by which it influences causal reasoning. Research using a range of techniques is needed to further our understanding of how far different sub-components influence causal perception/inference. Study 1 (Northrop, 2021) focused on how far encoding of spatial-temporal attributes of visual scenes explains variability in causal reasoning and more complex aspects of spatial-temporal performance. Using a detection of violations paradigm, data were collected from adults on their ability to accurately track the movement of an object behind an occlusion, and recognise whether it reappeared at the right point and right time. Ability to detect temporal violations predicted performance on a causal understanding task, self-rating of science ability and science occupation, but detection of spatial violation was not predictive. Study 2 (Berga, 2021), using an adolescent sample, examined the relationship between causal reasoning, spatial-temporal ability (measured using a relative arrival task) and use of scientific vocabulary, previously identified as a further predictor of causal reasoning. In line with our previous work, spatial-temporal ability was found to predict both accurate observation and explanation of causal processes, but scientific vocabulary was consistently the stronger predictor, and fully mediated the effect of spatial-temporal ability. Taken together, the two studies support the argument that a) spatial-temporal ability rests in particular on attention to temporal detail in observed phenomena, b) this facilitates construction of dynamic representations of causal processes, c) encoding of these representations using dedicated, unambiguous vocabulary supports their application to specific instances of causal observations, and d) these capacities are central to achievement in science.



## PA-004 Family socialization and child's development of theory of mind and interpretive theory of mind

Michael Weinstock, Morielle Holtzman
Ben-Gurion University of the Negev, Beer-Sheva, Israel

Family structure and mental-state discourse in parent-child interactions have been found related to children's development of Theory of Mind (ToM). Value differences are commonly referred to as a general factor to explain cross-cultural differences in ToM development, but little research has directly assessed parental values as another potential family socialization factor in ToM development. This study investigates whether parents' values and their mind-mindedness, which has also been suggested to be related to ToM as well as reflecting cultural values, is related to the attainment of ToM and the further development of interpretive ToM (iToM).

iToM represents an understanding of the subjective, constructive role of knowing in contrast to the earlier developing ToM, which includes understanding that people having different information will have different beliefs. Thus, we suspect that parents' values might have a stronger relation with iToM because different values may promote individual decision making and acceptance of autonomous

subjective perspectives to different degrees. Children socialized in individual norms environment will be more likely to expect and accept different perspectives, compared with children socialized with relational norms who will expect and value interpersonal agreement. While mind-mindedness has been found to be related to ToM development, as well as to account for cross-cultural differences in children's ToM, there is some question about its relative strength as a developmental factor. With that, we expect that emphasis on considering a range of mental processes of others might be a stronger factor in iToM than ToM development.

Fifty-six 3rd graders were assessed for iToM and ToM, using an ambiguous picture task. One of each of the child's parents completed the Portrait Values Questionnaire (PVQ) and the "describe-your-child" mind-mindedness task. The PVQ assesses a number of personal values which were then combined into four categories: openness to change and self-enhancement reflecting individual-oriented norms, and conservation and self-transcendence representing relational norms. The mind-mindedness variable consisted of the percentage of mental terms used in the description. Each of the variables was figured in two ways—as continuous variables to test for correlations and as categorical variables to better identify the meaning of relationships. The categorical configurations consisted of low/high of each of the value types; low, medium, and high mind-mindedness; and iToM, ToM without iToM, and neither.

Children's iToM was correlated positively with parents' self-enhancement values and negatively with conservation values. ToM was correlated positively with openness to change, and negatively with conservation. Parents with high self-enhancement values were more mind-minded and likely to have children with iToM than those with low self-enhancement values. Three-quarters of children of parents with medium mind-mindedness expressed ToM without iToM; half of those whose parents had high mind-mindedness expressed iToM.

In sum, the hypothesis were mostly confirmed with individual-oriented values positively related with ToM and iToM development, and relational values negatively related to their development. The results also show some differentiation between ToM and iToM in that different types of individual-oriented values correlated with each, and that degrees of mind-mindedness were differently related with ToM and iToM.



## PA-005 Recognition of mixed emotions across childhood using the analogue emotions scale (AES)

Francesca Fotheringham, Barbara Dritschel, Matthias Herman
University of St Andrews, St Andrews, Scotland

Mixed emotion is commonly defined as the co-occurrence of opposite valence (positive and negative) emotions. Previous research using film clips, with participants questioned about protagonists' emotions, suggests independent and spontaneous recognition of mixed emotions occurs between 5-7 years. These studies used a binary mixed emotion recognition reporting method, but provided little understanding of how children recognise multiple emotion interactions and its developmental

trajectory. Previous research used a method called the Analogue Emotions Scale (AES) which uses intensity and temporal dimensions to investigate mixed emotional development. Figure 1 depicts previous research's common AES emotion interactions. Previous research found that children aged 6-7 were more likely to plot a highly simultaneous (both positive and negative emotion following the same intensity and temporal tract) or inverse (positive and negative emotions negatively correlated) AES pattern compared to 5-6 year olds who were more likely to plot a single emotion or sequential pattern (positive and negative emotions not co-occurring but oscillating across time). Previous research also found an increase of the inverse AES pattern across adolescence, suggesting that development of mixed emotion recognition occurs throughout adolescence. However, there is no clarity about the developmental trajectory from childhood to adolescence. The present study of 301 (170 females; 131 males) AES trained, Scottish participants aged 4-13 (M=8.42), heard a house move vignette involving an age matched peer. The participants were informed of three anchoring points within the vignette: 1)found out about moving, 2)thinking of friends and 3)new school. Subsequently the participants were randomly presented with cards outlining six emotions (happy, sad, scared, calm, excited and anger), and corresponding emojis. The participants were asked what the vignette's protagonist felt, were prompted about choosing as little or as many feelings as they wanted and were reminded that they could re-hear the vignette and the anchoring events, before plotting each emotion. Participants plotted the intensity and duration of each emotion. To Investigate the developmental trend from a single to sequential to simultaneous mixed emotions, a chi squared test was employed and found a significant difference; $\chi 2(8)=61.444$, $p<.001$). Younger children more readily reported a single emotion, while older children were readily reported a pattern of simultaneous mixed emotion. A one-way ANOVA also showed significant age differences between the number of emotions chosen, ($F(4, 296)=17.714$, $p<.001$, $\eta 2=.193$, observed power=1.0). Further investigation considered how participants thought emotions interacted, finding that the inverse emotion pattern increased across the age groups (Figure 2). The vignette's emotional trajectory showed that positive emotions increased and negative emotions decreased with age, together with improved recognition of the expected intensity and interaction of multiple emotions. The results indicate that recognition of multiple emotions increases throughout childhood and that understanding of each emotion's intensity plays an important role in this development. This study demonstrates that mixed emotional development continues childhood to adolescence. The study's methodology is important as it shows that older children can accurately detect multiple emotion interaction intensity, providing new insight into the developmental trajectory of mixed emotion understanding.



## PA-006 The Development of Emotion Knowledge in Children with Autism Spectrum Disorders

Judith Bergold, Katharina Voltmer, Maria von Salisch
Leuphana University, Lüneburg, Germany

Emotion knowledge in children with autism spectrum disorders has become a hot topic in psychology in the last years. Specific components of emotion knowledge such as perception, understanding,

and regulation of emotions, have been discovered to be impaired in children who fall within the spectrum (Begeer et al., 2008; Mazefsky et al., 2013). This consequently leads to deficits in social-emotional reciprocity, a core symptom for these autism spectrum disorders. However, there are only a few studies that include great variety of components of emotion knowledge, which develop in children with increasing age. So currently no conclusions can be drawn about how the underlying components of emotion knowledge develop in children with autism spectrum disorders at different ages, and whether there are differences between the various diagnostic types (e.g. Asperger's syndrome, Childhood Autism, Atypical Autism). In addition, there is limited evidence of relevant factors associated with impairments of the specific components of emotion knowledge in children who fall within the spectrum. Our aim was to start to fill this gap. In the present study, the Adaptive Test of Emotion Knowledge for Three- to Nine-Year-Olds (ATEM 3-9; Voltmer & von Salisch, 2021) is used to investigate the development of seven components of emotion knowledge in children with autism spectrum disorders and compare them to those of typically developing children. In a further step, limitations in linguistic and cognitive abilities in children with autism spectrum disorders will be examined as possible predictors of their impaired emotion knowledge development. Data of 82 three- to ten-year-old children with an autism spectrum diagnosis, who were recruited from various therapy centers in Germany, will be presented. Children's age, gender, socio-economic status, number of languages spoken, language comprehension, ICD-10 diagnosis, IQ, and the working memory are considered as control variables. Initial analyses show that there are significant differences in the development of the specific components of emotion knowledge depending on the children's ICD-10 diagnosis. In children with Asperger's syndrome, the seven components are particularly well developed compared to typically developing children, while children diagnosed with Childhood Autism sometimes have deficits. These initial results are consistent with our hypotheses and will be analyzed further. In addition, possible causes for these findings will be pointed out and discussed. All in all, the results of the study will provide a more nuanced view of the social-emotional skills of children with an autism diagnosis. Furthermore, conclusions can be drawn about relevant factors that have an impact on the development and acquisition of emotion knowledge.



## PA-007 Searching for reflective belief revision in 2-year-olds

Kirsten Blakey[1], Eva Rafetseder[1], Zsófia Virányi[2], Giacomo Melis[1]

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Philosophers often hesitate to attribute epistemic and rational agency to infants and non-human animals because they appear to lack the ability to reflect on and re-evaluate their beliefs and their reasons for those beliefs. However, even if they cannot express this verbally, empirical research suggests that pre-verbal infants and non-human animals may be able to process demanding types of counterevidence known as "undermining defeaters" (which suggest that evidence is misleading), and to use this information to revise their beliefs and modify their behaviour accordingly. Here we

assess 2-year-olds' capacity to make inferences about the reliability of different sources of evidence based on whether the evidence the sources provide is misleading. In an object-search task we expose infants to reliable and unreliable sources of evidence, in the form of human informants. By comparing infants' responses to the different informants, we can assess whether they are sensitive to – or can reflect on – their reliability. Crucially, the informants provide evidence in three different contexts, putting the infants in the position to make a generalisation about the misleadingness of the evidence a particular informant provides, specifically, that different evidence coming from the same source can also be misleading. The capacity to process undermining defeaters and rationally revise their beliefs is expected to demonstrate an observable difference in infants' responses to novel information provided by reliable and unreliable informants. Therefore, if infants are suspicious the first-time they come across the unreliable informant in a novel context, this would be the best evidence we could find of a response to undermining defeaters. Such a response could indicate anticipations that the evidence given by this informant may also be misleading in this context. This, in turn, may be a sign that they have identified what the evidence is, and that they have assessed (negatively) its normative significance. Data collection is ongoing, however preliminary results suggest that 2-year-olds are less likely to follow the cues of an unreliable informant compared to a reliable informant in a new context.



## PA-008 Racial categorization and intergroup relations in preschool children: a focus on group membership and school diversity

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Developmental and social psychologists showed the importance of taking into account the context when studying the development of intergroup attitudes in children (for a review see Pauker et al., 2016). However, factors (i.e., relative group size, social status, diversity of the environment) that can impact these attitudes were studied separately and still need to be investigated.

In the present study, we examine the impact of group membership (high versus low social status) and environment diversity (high, medium and low diversified schools) on the development of racial categorization and the perception of cultural distance in 3-to-6-year-old children. We used a free categorization task including pictures representing children belonging to three racial groups (Caucasians, Black- and North-Africans) and a child-adapted scale of perceived cultural distance on three criteria (music, eating habits and language).

Results showed an age effect on the categorization task only in medium and highly diversified schools (see Figure 1). In addition, high social status children are more successful at the categorization task than low social status children. Regarding the perceived cultural distance, results showed a pro-White bias for the music and eating habits criteria. In addition, for the music criteria results showed a significant interaction between group membership and schools' diversity where intergroup biases

are only observed in highly and lowly diversified schools (see Figure 2).
This is the first study showing that the diversity of the environment plays an important role in the development of social categorization and the perception of cultural distance in preschool children.

## PA-009 Acquisition of Emotional Lexicon and Its Implications for the Theory of Emotional Concept Development

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Development of emotional concepts relates to the broader issues of the nature of emotions and the relationship between language and conceptual development. There is disagreement regarding the basic categories needed to characterize our rich and varied emotional experience. One approach posits universal basic emotions as "natural kinds", innate early developing systems scaffolding the acquisition of the corresponding emotional terms. Under another approach, the universal core of emotions consists of affective states (distress and pleasure, with different degrees of arousal/disengagement) interpreted as discrete emotions using language-specific emotional concepts. Under this approach, the order of acquisition of emotional terms would vary cross-linguistically, but the terms that most readily map onto the core affects emerge earliest. We investigated this prediction in two studies.
First, we examined emotional word trajectories in child French (European and Quebec), Spanish (European and Mexican), Italian, Danish, Norwegian, American English, Russian, Croatian, Greek, Cantonese, Mandarin, and Kiswahili using the Wordbank data (n=38,519). We established the order of emergence of emotional terms in each population using 25% of each sample producing each term as the criterion to compare the order of acquisition across languages. With near uniformity, terms for fear and disgust were the earliest: an equivalent of "scared" was first in 9 out of 14 and of "yucky" in another 3 samples (followed by "scared" in 2 of them). The order of other terms varied, but the observed pattern was for the positive (an equivalent of "happy") and one of the negative terms (either "sad" or "angry") to emerge before the second was added.
We also experimentally compared recognition of sadness and anger in Mandarin-speaking children (typically developing; n =79; M age=8.71; and with autism spectrum disorder (ASD; n=30; M age = 7.13). Children viewed pictures of situations paired with recorded sentences, stripped of emotional prosody, which contained sentence final particles (SFPs), optional elements in Mandarin that express speaker's emotional attitude towards the situation (sadness, anger). Control conditions contained analogous emotive sentences without SFPs and non-emotive sentences with and without grammatical (interrogative) SFPs. Children chose emojis for each situation-sentence among an array of four. TD group's accuracy was lower on "angry" than "sad" SFPs and on "angry" SFPs compared to the corresponding items without SFPs. For the ASD group, there was no significant difference between the two types and their performance on both was lower compared to the items without SFPs. Both groups performed better on grammatical compared to emotive SFPs, and grammatical SFPs com-

pared to the items without SFPs. Furthermore, while for both groups, performance on grammatical SFPs was predicted by age, for emotive SFPs, age was a significant predictor of accuracy only for the TD group. Thus, Mandarin-speaking children showed a delay in the acquisition of emotive SFPs compared to grammatical ones. In the TD group, this was driven by a greater difficulty of "angry" in younger children, who often labeled it as "sad", suggesting a difficulty differentiating between the two emotions.
We will discuss the implications of these findings to the theory of emotional concept development.

## PA-010 Preschoolers' emotion recognition from masked faces is influenced by age and maternal health anxiety

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Due to Covid-19 pandemic facial masks started to hide critical facial cues that help people identify others' emotions. While masks made emotion recognition challenging for both adults (Grundmann et al., 2021) and children (Ruba & Pollak, 2020),preschoolers were at particular risk as they are in a period where their emotion recognition skills are rapidly developing (Gori et al., 2021). Although negative influence of facial masks on preschoolers' emotion recognition has been shown, it is not known if this negative influence occurs regardless of the age of person displaying the emotion (child vs. adult). Due to their limited school experience during quarantine periods children interacted more frequently with adults and had increased exposure to facial masks of adults than their peers, which may have led them to better recognize emotions of adults behind the masks than emotions of children. Moreover, it is yet to be examined whether children's environmental experiences influenced their emotion recognition from faces covered with masks. Given mothers' critical importance in facilitating children's emotion socialization (Eisenberg et al., 1998), mothers' perceptions about pandemic may impact children's emotion recognition. Mothers with high levels of health anxiety during Covid-19 might show extreme cautiousness in social interactions, encouraging others and their kids to wear masks, and thus children of such mothers might be more frequently exposed to faces with masks and may have increased emotion recognition. Testing these possibilities, the present study investigated whether age of the person wearing masks (child vs. adult), and mothers' anxiety about Covid-19 impacts preschoolers' emotion recognition. Participants were 60 Turkish children between 4-6 years of age and their mothers. Children completed an emotion recognition task showing 20 pictures, half of which belonged to adults and the other half belonged to children with and without masks. The pictures displayed emotions of anger, happiness, sadness, fear and disgust equally. Mothers filled out Coronavirus Anxiety Scale (Lee, 2020) to report their stress related to Covid-19. The results showed that facial masks impaired preschoolers' emotion recognition as they more accurately identified emotions on faces without masks (M=.65, SD=.22) compared to faces covered with masks (M=.57, SD=.19), $F(1, 59) = 12.65$ , $p < .001$ , $\eta 2 = .18$. Moreover, children more accurately recognized the emotions of adults wearing masks (M=.62, SD=.24) compared to the emo-

tions of children wearing masks (M=.51, SD=.18), F (1, 59) = 16, p<.001 , ηp2 = .213 although this finding emerged only for recognition of happiness, but not for other emotions. Finally, mothers' Covid-19 anxiety positively contributed to children's accurate emotion recognition from adult (r=.33, p<.05) and child faces (r=.26, p<.05) covered with mask. These results pointed that decreased exposure to diverse facial expressions due to cover of the face negatively impacted preschoolers' identification of emotions, especially the emotions of their peers. But mothers' attitudes toward Covid-19 seemed to modulate this effect as children better recognized emotions of both adults and children if their mothers were highly anxious about the pandemic. These findings highlighted the interplay between social experiences and children's socio-emotional development. rn

## PA-011 Children's understanding of verbal irony in contexts with moral norm transgressions

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When a speaker uses an ironic utterance, a listener has to infer what the speaker actually believes and what they intend the listener to believe. Children often make incorrect inferences about the ironic speaker's belief and intention (e.g., Filippova and Astington, 2008), such as thinking that the speaker is being mistaken or lying (e.g., Demorest et al., 1983). The question is how children develop from making incorrect inferences to making correct inferences.

We hypothesize that moral norm transgressions function as a contextual cue for children to make correct inferences about the ironic speaker's belief and intention. Irony often occurs in situations in which norm-based expectations, such as moral norms, are violated (e.g., Wilson, 2013), and children disapprove of moral norm transgressions already from age 3 or 4 (e.g., Killen et al., 2011; Smetana & Ball, 2019). Children may therefore use their knowledge of moral transgressions to make correct inferences. In particular, the strong contrast between the negative valence of a moral transgression situation (e.g., child A breaking child B's toy) and the positive valence of the literal meaning of the ironic utterance (e.g., "You're so careful!", said by child B in response) should help children to correctly interpret the utterance. Based on this hypothesis, effects of moral transgressions on children's irony understanding have recently been investigated (Hukker et al., 2021; Köder & Falkum, 2021).

In the current study, we further examine the influence of moral transgressions by comparing intentional and accidental moral transgressions, as the former may provide stronger cues than the latter. From age 5, children's judgments of accidental moral transgressions become less negative (e.g., Cushman et al., 2013; Killen et al., 2011), due to children's developing Theory of Mind skills (e.g., Killen et al., 2011; Van Dijk et al., 2018). As a result, the contrast between the negative valence of the context and the positive valence of an ironic utterance's literal meaning becomes smaller. We hypothesize that accidental moral transgressions may therefore be a less salient contextual cue to irony understanding than intentional moral transgressions. As a consequence, we predict better ironic speaker belief and intention understanding in contexts with intentional compared to accidental moral transgressions.

5- to 8-year-old Dutch children and an adult control group participate in two tasks that both contain intentional and accidental moral transgressions. The relation between irony understanding and moral judgments is investigated by examining children's understanding of the ironic speaker's beliefs and intentions (task 1) as well as their judgments about the transgressor's naughtiness and deserved punishment (task 2). Data collection is still ongoing and will be finished by fall 2022.

## PA-013 Young Children's Comprehension of "We"

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Young children's thinking and behavior undergo a shift at 3 years of age with the emergence of group-mindedness, including norm enforcement and normative reasoning with partners (Tomasello, 2019). A conceptual advance underpins the emergence of group-mindedness in which children become able to conceptualize (3- or more-person) groups, in addition to (2-person) dyads. An open question is how group-mindedness affects language use.

We report three experiments that investigated effects of group-mindedness on interpretation of first person plural pronominal reference (English we). We possesses properties that render it useful for investigating the relationship of group-mindedness and language use. We is formally ambiguous such that, without context, children must rely on their intuitions (e.g., group-mindedness) to guide their interpretation of intended reference. We predicted that children who possess group-mindedness should more often infer that we is used to refer to groups than children who lack group-mindedness (who, instead, should favor dyadic interpretations). All studies were preregistered and conducted online. In Study 1, 32 2- and 32 4-year-olds watched scenarios in which it was unclear which of three puppets played an activity. An experimenter asked a puppet who played and the puppet responded, "We did." Children then had to interpret the intended referent of we. We predicted the abovementioned age difference in an ambiguous condition, in which the location of the speaker puppet speaker relative to the others was such that the referent of we could reasonably include either two or three puppets (Figure 1). In contrast, in an unambiguous condition, we predicted no age difference because the speaker's relative location pulled for dyadic interpretations. Results supported this prediction. The full model (that included the age-condition interaction) was weakly favored over models that lacked the term. Follow up analyses further supported our prediction (Figure 2). Two-year-olds did not distinguish between conditions. Moreover, in the ambiguous condition, 4-year-olds often interpreted we as referring to a group rather than a dyad. This suggests that maturationally constrained advances in social-conceptual skills influence language use.

Study 1 investigated comprehension of exclusive we (Cysouw, 2013), in which children were excluded from the referent of we. In contrast, Studies 2 and 3 investigated inclusive we, in which children were included in the referent. In Study 2, 32 2- and 32 4-year-olds colored with three puppets. Before coloring, a puppet noted that they needed markers so that "We can color." Children could distribute the markers to any number of puppet(s). In two control conditions, instead of using we the puppets

used we all or we both. We expected children in the latter two conditions to distribute the markers to all or one of the puppets, respectively. However, we expected 4-year-olds to distribute markers to more puppets than 2-year-olds in the critical "we" condition. Surprisingly, children tended to distribute markers to one puppet (Table 1). This may have been due to the procedure pulling strongly for a dyadic interpretation of we. Study 3 attempted to remedy this by introducing minor procedural changes. Data collection for Study 3 is roughly 50% completed.

## PA-014 The Relationship between Maternal Reminiscing Styles and Children's Print Awareness

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Research has shown that mothers frequently engage in reminiscing talk (elaborating on past events) with their children during everyday interactions. This type of talk supports children's language and memory skills (e.g., Fivush, Haden, Reese, 2006). Research has also shown differences in maternal reminiscing styles within sociocultural contexts. Some mothers adopt a high elaborative style, ask children questions about details, and build on what children say when talking about their experiences. On the other hand, some mothers adopt a low elaborative style and use repetitive talk (Leyva & Smith, 2016). Most research examining differences in maternal reminiscing styles is with cultural groups living in the US and few in other cultures (e.g., Wei et al., 2020, Wang, 2004). Thus, more research in different sociocultural contexts is needed. This study examines the specific features of maternal reminiscing talk and whether the features of this talk vary by the age of children and the type of the event (positive and negative) in the Turkish sociocultural context. This study also explores the relationship between maternal reminiscing talk styles and children's vocabulary skills and print awareness. A total of 45 parent-child dyads participated in this study. Children were 4- to 6-year-olds. Mothers were asked to record their conversations about past events with children at home. When collecting recordings, the experimenter conducted a home visit and administered Peabody Picture Vocabulary Test (PPVT) and Print Awareness Scale to measure children's vocabulary and print skills. Parent-child conversations were transcribed verbatim and coded for their grammatical structure (question or statement) and content (descriptive, explanatory, repetitive/conversational). The findings showed that when talking about past events, mothers asked more questions than they provided statements and used descriptions more frequently than explanations. Mothers also used more descriptions when discussing positive past events than negative past events. To identify maternal reminiscing styles, we conducted a k-means cluster analysis on the proportions of talk categories above for positive and negative events separately. For positive events, two distinct styles emerged from this analysis: 1) mothers who engaged in descriptive and repetitive talk and 2) mothers who engaged in explanatory talk. Mothers with an explanatory style had children with better print awareness skills than mothers who engaged in repetitive descriptive talk. There were no differences in children's vocabulary scores across different styles. For negative events, there were also two

distinct styles, but the pattern was different: 1) mothers who used only conversational/repetitive talk without any descriptions, and 2) mothers who used descriptions but no explanations. Children's print and vocabulary skills did not differ across the two maternal reminiscing styles in negative events. An important reason for this difference between positive and negative events may be that mothers used more limited language about negative events than positive events. In contrast, they used more detailed language about positive events than negative events. These findings corroborate and extend previous ones about differences in mother-child reminiscing interactions in different sociocultural contexts. We discuss the possible effects of these findings on supporting children's literacy development in the early years.

## PA-015 "Boys Will be Boys": WEIRD Adults' conformity expectations vary by children's gender across highly desirable traits

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The understanding of social norms and expectations of conformity shape people's everyday behaviors and also determine the values future generations will embody. Previous research shows that compared to adults from small-scale, non-industrialized societies, U.S. adults are less likely to associate conformity with highly desirable traits (e.g., intelligence, excellence in school, or discipline) but this has only been studied in the context of evaluations of a female instructor and female children (Clegg et al., 2017; Wen et al., 2019). However, evidence also suggests that socialization is different (Bian et al., 2017; Leslie et al., 2015) for female and male children in Western Educated Industrialized Rich and Democratic (WEIRD), English-speaking environments, in a way, where boys are expected to be smarter and "think outside of the box", while girls are encouraged to follow the rules. Therefore, in the current study we examined adults' conformity judgments for highly desirable traits (smart, well-behaved, gets good grades) across male and female children.

We collected data online (N = 1295) from five WEIRD, English-speaking countries (Australia, Canada, New Zealand, United Kingdom, United States of America). Similar to previous studies (Clegg et al., 2017; Wen et al., 2019), adult participants were presented with an adult model who made a necklace featuring non-essential steps and then two children who also each made a necklace. One child (high conformity) followed the exact same steps as the adult model, and the other child (low conformity) did not follow same the steps and used three more beads than the adult model. After watching the videos, participants were asked 1) which child is smarter, 2) who is more well-behaved, and 3) who gets better grades at school. The gender of the adult and child videos were matched and counterbalanced.

A GLMM showed a significant effect of gender across all traits, and the effect was significant regardless of the participants' own gender. Overall, participants showed higher odds (1.82) of endorsing a high conformity child as displaying the traits of interest when they were female than when they were male (b = 0.60, p < .001, 95% CI: 1.34, 2.47). Furthermore, we found no significant differences in participants' responses across the five countries, and there was an overall preference for a high conformity child in all three traits. However, there was a significant difference in how much conformity was endorsed for all three traits. The high conforming child was chosen as well-behaved more often than chosen as smarter (b = -1.35, p < .001, 95% CI: 0.20, 0.33) and getting better grades (b = -0.84, p < .001, 95% CI: 0.34, 0.55).

In the study, we discuss the implications of this gender bias in conformity expectations in early childhood. Furthermore, we suggest diversifying research in this subfield. We believe that studying conformity judgments and learning in a diverse array of populations will allow us to develop an understanding of the role of cultural norms and the intersectionality between norms and gender biases.

## PA-016 On the late acquisition of conditionals: conceptual vs. psycholinguistic explanations

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Children produce conditionals (if-clauses) later than other complex constructions (e.g., because-clauses, when-clauses) for reasons that are poorly understood [1-4]. On a conceptual explanation, children acquire conditionals later because they are cognitively more complex (e.g., hypothetical) than other constructions [1-3]. On a psycholinguistic explanation, children produce conditionals infrequently because their meaning can also be conveyed by alternative constructions [1,4]. However, relevant evidence comes primarily from naturalistic studies of children's spontaneous production, thus making it hard to adjudicate between competing explanations. Here, we revisit children's production of conditionals by eliciting descriptions of events with simple conditional/causal structure. Unlike prior research, we tested both children and adults and manipulated the hypotheticality of events.

Eighty 3-to 6-year-olds and 20 adults were presented with a causal toy (a box that lights up if you put the "right block" on) and were shown by a teacher-puppet how it works. Then, participants taught a student-puppet how to make the box light up. In low-hypotheticality trials, the student-puppet requested information in the present indicative form; in high-hypotheticality trials, the student-puppet made a failed attempt to light up the box (by using the inactive block) and requested information in the past counterfactual form (Fig.1).

Participants' verbal responses were recorded. On the conceptual explanation, children should use conditionals less than other constructions-especially in high-hypotheticality trials-but no such difference should be found in adults. On the psycholinguistic explanation, children, similarly to adults, may use conditionals and other constructions equally frequently. To assess the complexity of participants' responses, we first coded for mention of antecedent (block on box) and consequent propositions

(box lights up), and how these related (Fig.2).
Inspection of the data demonstrated that children overwhelmingly mentioned antecedents only in a main clause, while adults mentioned both propositions and preferred subordinate constructions. A mixed effects logistic regression on mention of subordinate clauses confirmed these observations: an effect of age revealed that adults were more likely to use subordinate constructions than children (MAD=.65, MCH=.25). There was also an effect of trial type, qualified by an interaction of trial type and age: 6-year-olds were more likely to use subordination in low- than high-hypotheticality trials (MLOW=.36, MHIGH=.21), but there was no such difference in younger children (MLOW=.24, MHIGH=.22). To assess the frequency of each type of construction in participants' responses, we coded the types of subordinate clauses used (Fig.3). Inspection of the data demonstrated systematic use of conditionals after age 5. Log-linear models tested the fixed effect of clause type on counts of mention in each age group and trial type. Results showed that mention of conditionals did not differ from mention of other complex constructions (temporal, causal) at any developmental stage (Table1). In sum, unlike prior naturalistic studies [1-4], our experimental investigation shows that conditionals are not delayed compared to other constructions of similar morphosyntactic complexity, in either low- or high-hypotheticality scenarios. Overall, these findings support the psycholinguistic explanation of children's late production of conditionals and inform our understanding of the factors that affect the order of acquisition of semantically complex constructions.



## PA-017 Predictors of grammatical competence measured with Sentence Repetition Task in bilingual children's Polish: does cultural background matter?

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Factors that are often examined in exploring language proficiency in bilingual children are current input, current output, and age of first exposure (Bedore et al., 2012; Mishina-Mori et al., 2011; Hoff et al., 2012). Quantity and quality of language exposure are documented to be crucial factors of language development (Abbot-Smith et al., 2018; Romeo et al., 2018).
Language exposure can vary, and this variation may be related to the cultural context. Bilingual children can represent various groups of cultural background (Laketa et al., 2021). For the following paper, we are focusing on two of them. The first one is a group of children brought up predominantly in one culture. These are children acquiring a second language either in a bilingual kindergarten/school or through parents who decided to introduce an additional language to their children (intentional bilingualism). The second group is composed of children raised in a bicultural context, whose families moved to another country or whose parents come from two various cultures.
The aim of our study was to check the possible predictors of grammatical competence, measured with Sentence Repetition Task (SRep) in the two groups. We included age of exposure, parental in-

put, non-verbal intelligence, number of siblings, We used Sentence Repetition Task for Polish - short version (Przygocka et al., 2021) and Questionnaire for Parents of Bilingual Children (PABIQ, Gatt et al., 2011). The process of data collection is still ongoing. By the end of December 2022, we will have collected data from 50 children. We expect that non-verbal intelligence will be a predictor of grammatical competence for both of the groups, and think that the two groups will differ in relation to the types of errors they make in SRep. In the talk, we will present both the quantitative analysis comparing the two groups in terms of their grammatical competence, as well as a qualitative analysis of the errors made by children from each of the groups.

## PA-018 Prediction errors drive preschoolers' curiosity

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Human and artificial agents perform better in a variety of learning tasks when they are driven by curiosity (Ten et al., 2021). Specifically, their intrinsic motivation to learn pushes them into choosing environments that offer better learning opportunities, resulting in enhanced knowledge of the world around them. However, the developmental origins of curiosity-driven learning are still unclear. When children explore novel environments, their curiosity might either be driven by learning progress, in a way that resembles adults, or by prediction errors, which signal situations they know little about. To investigate this, we tested 4-year-old children and adults in a learning task in which they could freely explore different unknown environments that contained learnable patterns of events. Three characters were available at any time, and participants could decide which one to play hide-and-seek with (Figure 1). The chosen character hid behind a hedge following a predictable (yet noisy) pattern, and children had to guess where the character was hiding. Crucially, the task design allowed them to switch which character to play with at any moment in time, thus offering a way to examine when they decided to explore and what drove their exploratory decisions.

To better assess their performance and exploratory strategies, we fit participants' behavioural responses to a hierarchical reinforcement learning model (Poli et al., 2022). This allowed us to obtain trial-by-trial estimates of each participant's prediction errors and learning progress on the task and link these to participants' sampling choices. With this approach, we found that exploration is driven by different mechanisms in adults and children. Adults (N=67) explore the environments relying on learning progress: They pick environments where they can learn the most, abandoning the ones where learning is absent or scarce. However, preliminary data on 4-year-old children (N=48) indicate that children prefer to maximize prediction errors: They remained engaged in situations where predictability is minimal, actively seeking those situations, and disregarded predictable stimuli. These results indicate a stark developmental change in curiosity-driven learning and contribute to our understanding of the unique mechanisms that underlie children's learning and exploration.

## PA-019 Can a Causal Relational Matching-to-Sample Task Reveal Abstract Reasoning Abilities in Preschool Children?

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The relational matching-to-sample task (RMTS) is considered the gold standard in measuring abstract concepts like same and different. Most 3-and 4-year-olds, as well as non-human animals, do not spontaneously succeed in the classic, two-item version of the RMTS task. Thus, it has been suggested that the ability for abstract relational reasoning only develops later in humans and might be dependent on language. Kroupin & Carey (2021) argued that RMTS failure does not necessarily result from a lack of abstract reasoning abilities but could instead stem from inductive biases for other bases of matching. There is evidence that English-speaking children are biased toward matching individual objects rather than matching relations between objects. Moreover, slight task modifications like the presentation of multiple exemplars, variable matching-to-sample training, or a narrated causal context have increased preschoolers' success in RMTS tasks. We developed a physical, causal RMTS task for 4-year-old children based on matching the weight relations within object pairs. The causal mechanism of this novel task nonverbally specifies the relations within object pairs as the only relevant basis of matching. To obtain a reward, the tilt of two seesaw apparatuses, a larger "gate" and a smaller, reward-containing "car", must be aligned so that the car can be pulled through the gate. In each trial of the causal RMTS task, the two objects in the sample pair (AA or BC, depending on the trial type) are placed on either side of the "gate" seesaw. Then, both objects of the choice pair selected by the participant (DD or EF) are distributed on the "car" seesaw. If the participant chooses the correct relational match, the tilt of both seesaws is aligned (both in balance or both tilted), and the reward can be obtained. When an incorrect match is chosen, the misaligned seesaws block the reward. If the children already have the capacity for abstract relational reasoning, and failure in the classic RMTS task is due to an inconclusive basis of matching, then the causal version should improve performance compared to a control group's choices in the classic task. To investigate the robustness of this effect, both groups are then presented with a transfer task using a novel set of stimuli in the classic, non-causal RMTS design. Additionally, we included conflicting object matches in half of the trials. As in the causal RMTS task, object matches between seesaws are clearly causally irrelevant, their negative effect on the relational matching performance should be reduced compared to the classic task. Data collection with children is currently ongoing. A pretest confirmed that 4-year-olds understand the objects' weight differences and the seesaw mechanism. Due to its non-verbal design, the causal RMTS task can further be used in investigating the reasons behind non-human primates' failure in the classic RMTS task.

## PA-020 Foods versus non-foods categorization in children and adults

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Categorization is an essential part of our daily lives and much of the research in children's categorization strategies has focused on natural kinds and human-made artifacts. For natural kinds, children rely on internal properties as an indicator of its category membership, while for artifacts, children use the function to determine category membership. However, it is unclear how foods fit in these categories since they can be both natural and human-made (processed) and satisfy the function of being fit for consumption. This is a critical question given food's importance in our daily lives.

Therefore, this research examines the effect of transformations that alter either the internal properties or function on an item, on judgments of category membership of four types of items: human-made artifacts (e.g., pencil, ball), non-food natural kinds (e.g., branch, cactus), natural foods (e.g., apple, broccoli) and processed foods (e.g., chocolate, bread).

Across two studies, 4- and 5-year-olds, 6- and 7-year-olds, and adults (N = 189) viewed pictures (Study 1) or were told stories (Study 2) about human-made artifacts, non-food natural kinds, natural foods and processed foods undergoing four possible transformations: crushing (Study 1), cutting (Study 1 & 2), removing insides (Study 2) and melting (Study 2). In both studies participants were asked whether the transformed item was part of the original category or not (e.g., "Is it an apple or is it not an apple?"). We recorded participants' same-item responses, indicating the transformed item was part of the original category (e.g., participants judged that a cut apple was still an apple). In both studies, a linear mixed-effects model was conducted to analyze the probability of giving same-item responses depending on Age, Transformation Type and Item Type.

In Study 1, the results revealed two 2-way interactions: Transformation Type x Age ($\chi2$ (2) = 16.45, p = .00027) and Item Type x Age, ($\chi2$ (6) = 45.26, p < .0001). All participants gave more same-item responses for cut than crushed items and only the older participants gave more same-item responses for foods compared to non-foods.

In Study 2, the results revealed three 2-way interactions: Item Type x Age ($\chi2$ (6) = 35.32, p < .0001), Transformation x Age ($\chi2$ (4) = 77.50, p < .0001), and Transformation x Item Type ($\chi2$ (6) = 38.06, p < .0001). All participants gave more same-item responses for foods compared to non-foods, and the older participants gave more same item responses for processed than natural foods. In addition, the older participants provided fewer same-item responses for melted items compared to the other two transformations.

Overall, the results provide meaningful insight into how individuals determine category membership

for natural and processed foods as opposed to natural kinds and artifacts. It suggests that children and adults do not merely categorize natural foods as a natural kind nor processed foods as an artifact. On the other hand, the results suggest that older children and adults do consider the origins of an item (whether it is natural versus human-made) to make category membership judgment within the food domain.

## PA-021 Frog, where are you? Investigation of narrative skills in bilingual and monolingual children through eye-tracking

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Narratives reflect the cognitive and emotional states of the actors which are connected temporally and causally (Aksu-Koç & Aktan-Erciyes, 2018). Therefore, narrative skills play an important role in the development of children's linguistic and cognitive skills. Research examining L1–L2 interaction has often been limited to specific language pairings, in contexts where the L1 is the minority language and L2 is the majority language (e.g., Severing and Verhoeven, 2001). Previous studies indicate that exposure to L2 at an early age may have negative effects on narrative skills (Aktan-Erciyes, 2019; 2020) The present study investigated narrative skills of monolingual and bilingual children. We asked: What are the consequences of intense and early exposure to L2 on the structural, linguistic, and perceptual processes of narrative skills for children? For this purpose, a total of 173 monolingual (L1:Turkish,n=95) and bilingual (L2:English,n=78) children aged 5, 7, and 9 years were tested. Participants followed the pictures of the story Frog, Where Are You? (Mayer, 1969) on a computer screen through eye-tracking device. L1-Turkish narratives were coded for linguistic complexity (Berman & Slobin, 1994), narrative quality (Pearson, 2002), and perceptual processes (Figure-Ground-Dynamic–Static state AOI). We administered standardized word comprehension tests for each language. Test of Narrative Language was used to assess narrative comprehension. Participants also completed verbal digit span and DCCS (Dimensional-change-card-sort Task) to assess their working memory and cognitive flexibility. We compared bilinguals and monolinguals using Repeated-Measures ANOVA for narrative quality, linguistic complexity and eye-tracking measures as DVs. Results indicated that bilingual and monolingual groups did not differ in their narrative quality for neither of the coding elements (i.e., Frog Story Elements, Sequence, Perspective/Affect, Engagement) linguistic complexity and eye-tracking measures (Figure, Ground, Dynamic, Static AOIs) (all F's <1.23, all p's> .05). There were only age-group differences for narrative quality scores: 7- and 9-year-olds performed better than 5-year-olds, but no difference between 7-and 9-year-olds. Based on the eye-tracking data, the dynamic-narrative style and the static-technical style suggested by Holsanova (2001) were tested. However, there were no differences in attention allocated to Static vs. Dynamic scenes between monolinguals compared to bilinguals. Both language groups attended more to Figure compared to Ground.

We also performed linear regression analyses to reveal what predicts narrative competence and attention allocation to specified AOIs. Results indicated that better L1-vocabulary, higher linguistic

complexity, higher narrative comprehension were associated with higher narrative quality scores. Specifically, higher Perspective/Affect scores were associated with being bilingual. For Engagement scores, attending more to Figure AOIs and less to Static scenes were associated with higher competence.

Results indicate that monolingual and bilingual children might not differ in their L1-narrative competence for most aspects and that different attention allocations might be associated with selective narrative competence. Being bilingual might be associated with more reference for emotions and intentions in narrative reflected in Perspective/Affect which might further be related to enhanced ToM skills. Results will be discussed within Bruner's (1986) narrative perspective of Landscape of Action and Landscape of Consciousness.

## PA-022 Learning from and about others: when reasoning about testimony, children consider both where it came from, and what others believe about its source

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When receiving information from others, we must decide whom and what to believe. Even preschoolers are discerning learners, considering whether informants were previously accurate, or had perceptual access to relevant information. But our informants don't always acquire their knowledge firsthand, and often, those around us may know more about their track record than we do. To evaluate testimony, we must sometimes look past our direct informants, considering: 1) where their information came from, and 2) what others believe about them.

Investigating the first capacity, three preregistered experiments (N=360) investigate whether four- to seven-year-olds consider informants' sources, testing when children begin favoring well-sourced claims over those that are simply more widely-repeated. See Fig 1 for the procedure and results. Across all experiments, participants observed individuals disagree; when asked to justify their claims, one side always referenced three independent eyewitness sources, and the other referenced only one. After seeing this, participants were asked to endorse one side's testimony.

Importantly, each experiment manipulated the number of individuals who initially disagreed. In Experiment 1, two agents initially disagreed; by age five, children endorsed the claim supported by more primary sources. In Experiment 2, each claim was repeated by multiple intermediaries (something even adults can struggle to reason about; Yousif et al., 2019). Six-year-olds endorsed the side with more primary sources, while five-year-olds were at chance, suggesting they may prioritize source information only in the absence of widespread repetition. Finally, Experiment 3 equated the number of overall individuals endorsing each claim, pitting three individuals who heard from one primary source against a single dissenter who actually heard from three primary sources. Again, by age six—but not

before—children endorsed the testimony of the individual with multiple primary sources, suggesting that older children did not solve Experiments 1-2 by simply siding with the more numerous group. Together, this work suggests young children already understand the complex social processes that construct the knowledge of those around them—but may only converge on a stable strategy to evaluate repeated testimony by age six, after considerable social experience. The intermediate developmental trajectory of five-year-olds, however, raises an intriguing possibility: maybe young children expect agents to repeat testimony they think is true. If so, widespread repetition of a claim could signal others believe an agent is particularly knowledgeable or trustworthy.
A preregistered study (N=90 four- to six-year-olds) begins investigating this capacity, testing if young children decide whom to trust by observing whether others believe a source. See Fig 2 for the procedure and results. A third party accepted one agent's testimony, and subtly questioned the other's; by age five (but not before), participants judged that the agent whose testimony was challenged was likely wrong. This work provides some first hints that children may not only evaluate informants on the basis of their own experience—they may also notice and consider what others think about them.

## PA-023 Exploring the role of social context and collaboration on children's tool innovation rates

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Children have often been described as "poor innovators", being more prone to learning new solutions socially than inventing them individually. Yet, this conclusion might be premature: many studies have investigated children's innovation skills in somewhat artificial social contexts, resulting in potentially underestimating children's abilities. First, in many studies the interactions between child and experimenter are limited, with the experimenter acting withdrawn – often in contrast to the warm-up. This could make the testing situation odd to some children, possibly inhibiting their exploratory behaviour. Second, while we know that innovations are often the product of cooperation between two or more individuals rather than the achievements of "lone geniuses", children are often tested individually. We hypothesize that children's innovation rates increase if the testing context allows for more interactions between child and experimenter and if children can work in pairs. In this study we test 4- to 6-year-old German children in an associative tool use task (a more difficult version of the hook task). Children are randomly assigned to one of four conditions (each with n = 30 children/dyads): asocial baseline condition (child tested individually, experimenter distanced, only general encouragement); adult-child interactive condition without pedagogical cues (child tested individually, experimenter sits with child, more interaction than in baseline but only general encouragement); adult-child interactive condition with pedagogical cues (child tested individually, experimenter sits with child, pedagogical questions and comments to support child in thinking through the problem and limit perseverative behaviour); peer interactive condition (children tested in pairs; experimenter

distanced, only general encouragement). Children are provided with a variety of tools (some ready to use, some require modifications) and 10 min time. We measure aspects of task success, milestones reached, playtime, latency, and originality of solutions. We will present the results of this study for which data collection is still ongoing at the time of submission.

## PA-024 Young Children's Experimentation, Data Interpretation, and Justification Abilities

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Experimentation and data interpretation are core components of scientific reasoning (SR) and vital to students' understanding of science (Zimmerman & Klahr, 2018). A growing body of research suggests that already in early childhood, children hold hypothesis testing and data interpretation skills, showing further growth with increasing age (Koerber & Osterhaus, 2019; Piekny et al., 2014). However, studies on children's explicit awareness in SR are scarce; it is unclear if an implicit awareness emerges before an explicit judgment capacity (Sodian, 2018). The present study investigated children's data interpretation and experimentation competencies and explicit awareness by examining their decisions in a forced-choice paradigm and corresponding task judgment justifications. Our final sample included 89 boys and 78 girls (N = 167, M_age = 7;5, SD = 1.54 months). Using validated SR task batteries, we tested children's understanding of a conclusive test and their ability to evaluate various data patterns (Science-K and Science-P Reasoning Inventories; Koerber & Osterhaus, 2019; Osterhaus et al., 2020). Children's task success rates were analyzed. Additionally, we used open-ended questions to elicit children's task judgment justifications, coding the extent to which they correctly referenced given data patterns and proposed sensible variable contrasting and variable control strategies. On average, children correctly solved three out of seven forced-choice data interpretation tasks (Mdn_success = 42.9%, SD = 18.7%). This aggregate performance was not significantly above chance ($p = .642$). However, we found substantial success rate variability across single tasks, suggesting that children did not follow a guessing strategy: They best interpreted perfect covariation data (82.4% success rate), were variably successful at confounded data items (M_success = 41.5%), and displayed marked difficulties in evaluating imperfect covariation data (M_success = 35.5%). Overall, their justifications entailed either ignorance of data or unspecific data pattern references (Mdn_score = 3, SD = 3.44, max. score = 21). However, there was substantial variability across single tasks, with up to two in three children (62.1%) providing justifications with correct, specific evidence references. In experimentation, children, on average, correctly solved six out of eight forced-choice tasks, performing significantly above chance ($p < .001$; Mdn = 75%, SD = 24%). They achieved a 54% and 77% success rate on conclusive test items and control of variables items, respectively. Their justifications tended to demonstrate a general understanding and use of variable contrasting but the negligence of variable control (Mdn_score = 1, SD = .94, range = 0–3). One of five justifications (22.3%) showed an advanced understanding and use of variable contrasting

and control. Our results confirm that SR skills are present in young children, showing higher success rates and more adequate justifications in experimentation than in data interpretation. Moreover, our findings indicate the emergence of explicit awareness in SR during elementary school age: Children's justifications generally aligned with their task choices, and they demonstrated judgment capacity beyond implicit awareness, using reasoning grounded in the systematic use of variable contrasting and partial competence to reference given data patterns correctly. The current work is informative for understanding children's development in SR skills.

## PA-026 The neonate brain's sensitivity to repetition-based structure: specific to speech?

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Newborns are able to extract and learn repetition-based regularities from the speech input, i.e. they show greater brain activation in the bilateral temporal and left inferior frontal regions to trisyllabic pseudowords of the form AAB (e.g. "babamu") than to random ABC sequences (e.g. "bamuge"; Gervain et al., 2008, 2012). Is this sensitivity specific to speech and language?

To answer this question, we tested whether newborns are sensitive to repetition-based regularities when those are implemented with musical tones. Twenty-three neonates listened to blocks of AAB and ABC tones sequences (fourteen blocks per condition and ten items per block) while their brain activity in the temporal, parietal and frontal areas was recorded using functional Near-Infrared Spectroscopy (fNIRS). Each of the 20 unique syllables comprising the stimuli in the original study with speech (Gervain et al. 2012) was mapped onto a different piano tone. Thus the paradigm, the frequency of occurrence and the distribution of the tones were identical to those of syllables in Gervain et al. (2012).

The permutation analysis over oxyHb concentration changes revealed four significant clusters of channels where brain activity differed between the AAB and the ABC conditions: one in temporal and one in fronto-parietal areas in both hemispheres. A linear mixed effects model over these clusters revealed a significant main effect of condition due to larger inverted (negative) responses to AAB than ABC. The main effect of time was also significant due to a general decrease in response amplitude over time.

These findings show that newborns' ability to discriminate AAB from ABC sequences is not specific to speech – it also extends to musical tones. However, the neural response is markedly different. First, we observed a strong overall habituation pattern over time, whereas for speech an increase was present over the time course of the study. Second and relatedly, the repetition regularity gave rise to an inverted hemodynamic response, while it was canonical for speech. Thus newborns' ability

to detect reduplication is present in auditory modalities other than speech, but the underlying brain mechanisms may be different.

## PA-027 Perception of the link between manual action and magnitude in 6-month-old infants: a multi-dimensional investigation

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Human action perception system might have evolved in interaction with a possibly innate ability to conceptualize magnitude information (such as size, numbers or time). However, the developmental pathway of a link between numerical and action processing has still received few research attention. Studies suggest that six months old corresponds to an important stage in manual action production and perception development. Infants of this age start to exhibit mature thumb-opposite grasping (Butterworth et al., 1997; Daum et al., 2011) and are able to predict others' reaching actions (Kochukhova, Gredebäck 2010; Kanakogi, Itakura, 2011). Previous studies demonstrated that six-month-old babies were able to infer the goal object of a grasping action based on the experimenter's hand aperture and the goal object's shape (Daum et al., 2009, 2011). Since action perception may involve motor resonance (Natale et al., 2014), it may be hypothesized that infants' motor system is also regulated by information of magnitude when observing manual actions.

In the current study, we adopt an original multi-dimensional approach to investigate whether and how six months-old infants would interpret and predict others' grasping actions by relying on magnitude information, such as object size. The paradigm consists in short videos in which an adult hand is opening in a small or large grip aperture ("hand opening phase"), and is then directed towards either a small or large wooden cube ("object reaching phase"). Each infant attends eight different videos presented in a random order, in which the hand opening either matches or not the size of the targeted object ("congruent" and "incongruent" conditions). We couple behavioral measures, including eye tracking, with surface electromyography (EMG) recordings of forelimb muscles' activity in young infants.

Our hypotheses are threefold. Firstly, we predict that infants will be able to anticipate the goal of the grasping actions based on magnitude information, i.e. that during the "hand opening phase", subjects will direct their gaze towards the object whose size fits the hand's grip aperture. Secondly, we expect that young infants will differentiate congruent from incongruent conditions (i.e., in which hand aperture and object size match or mismatch). Such results would corroborate findings from Daum et al. (2009, 2011). The incongruent conditions should thus elicit longer gaze durations during the "object reaching phase", and surprise induced by the unexpected action may be reflected by pupil dilatation. Finally, our third prediction is that motor resonance will be exhibited during the "object reaching phase", with infants' muscle activity amplitude correlating with information of magnitude, in congruent but not incongruent conditions.

Considering that infants' sensorimotor grasping skills might affect their ability to predict such manual actions (Gredebäck, Kochukhova, 2010; Daum et al., 2011; Kanakogi, Itakura, 2011; Bakker et al., 2015), we will assess which type of grasps the subjects are able to perform (from "ulnar grasp" to mature "pincer grasp"), using questionnaires and a simple object grasping task.
This multidisciplinary project will contribute to gain insights into the development of magnitude concepts by characterizing them in relation with action perception and motor development.

## PA-028 Do 10 - to 12 - month-old infants accept non-native phoneme as object labels or as mere sounds?

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Newborns have openness for all languages. However, as they grow up, their perceptual sensitivities gradually align with the phonological structure of their native languages. Moreover, infants loose an ability to discriminate nonnative phonemes by the age of 10- to - 12-month-olds (Polka & Werker, 1994, Werker & Tees, 2002). About the same time, they are aware of important feature of languages, a function of representation. They assume one-to-one mapping between words and objects (Dewar, & Xu, 2007). Adapting native language and learning labels are interdependent. Only when referential cues are available, infants can learn nonnative sounds as labels (May & Werker, 2014). But it is unclear that infants accept nonnative sounds as labels of native language or of nonnative language. In addition, previous research on word-object mapping investigated the infants with switch task. This paradigm can investigate sounds-objects association but cannot investigate whether infants assume these sounds as "languages". That is, this paradigm cannot distinguish the function of representation from the mere association. In this study, monolingual Japanese infants between 10- and 12- month-olds participated (n=39). To investigate whether the infants consider nonnative sounds as labels or as mere sounds, we tested one-to-one mapping in English (nonnative) or Japanese (native) pronunciation nonwords using violation of expectation paradigm. English labels were chosen based on phonetical illegalness in Japanese, so that infants are easy to perceive English label as nonnative labels. The current study consisted of familiarization and test phases followed by Byers-Heinlein (2017). In the familiarization phase, infants were familiarized with two types of outcomes: two identical object or two different objects. Test phase began soon after the familiarization phase and was different from familiarization phase in labeling before objects appeared. All infants experienced 4 conditions: One label - identical object, one label – different objects, two labels – identical object, and two labels – different objects. we hypothesized if infants were aware of representative function of language regardless of their native language, they would be surprised at the different objects outcome when hearing only one label and at the identical object outcome when hearing two labels in both English and Japanese labels conditions.
We analyzed total looking time in the test phase using 2×2×2 mixed ANOVA, with language (English vs. Japanese) as a between-subjects factor and number of labels (one vs. two) and object– pair

appearance (identical vs. different) as within-subjects factors. The result revealed that the looking time in one label condition was significantly shorter for the identical object outcome (M= 4.25 s, SD = 3.42 s) than for thein different objects outcome (M = 6.23 s, SD = 3.26 s) only when labels were pronounced in Japanese style (F (1,36) =4.77, p = 0.042). This finding suggests that infants expect one to one mapping in their native language and noticed a label represents an object. But this representative function was not applied to nonnative sound labels.

## PA-029 The development of the social N400: Semantic systems are utilized to mentalize from infancy to adulthood

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Recent findings on the so-called social N400 response1–3 hint that a neural marker of semantic processing, the N400 event-related potential (ERP), may not simply be sensitive to social context, but may operate as means of mentalistic computations4. The aim of this paper is providing a brief overview of recent findings and reporting new data. Both preverbal 14-month-old infants and adults have been found to produce an N400 in the place of another person, when they were tracking her comprehension. In these experiments both infants and an Observer saw an object, but only infants saw that it was replaced with another object: when the latter was labelled, correctly from infants' perspective, the label was incongruent with the Observer's (false) belief.5 The appearance of an N400 in such a mentalistic task was intriguing: according to the received knowledge there was no need for effortful retrieval from semantic memory systems, which the N400 is believed to be indicative of6,7. Moreover, 14-month-olds produced an N400 not only when they experienced a correct and another person an incorrect label, but also when the other person heard a correct label that was incorrect from their own perspective8. Despite the fact that semantic memory systems were sufficiently pre-activated by the objects, if either parties experienced a mislabeling, an N400 appeared, suggesting that it may code semantic activations for communicative interactions, not simply for individual comprehension. However, new data from our lab shows that the mentalistic N400 undergoes an intricate developmental trajectory from infancy to adulthood. Adults produced no N400 when they experienced a mislabeling, if the label was correct from the perspective of another person (Figure 1). Importantly, no additional ERP responses were observed that could have indicated mentalistic computations (similarly to previous experiments with adults, where the social/mentalistic N400 was not accompanied by other ERP markers1,2,4). When instructed to follow the comprehension of another person, participants' brains responded as if the label they heard were not incongruent with the object in front of them: their mentalistic attribution of comprehension reduced the N400 as if labels were correct for themselves as well – not only for the other party. Note that the N400 is best understood as elicited by default and reduced to the extent semantic predictions are met6, which means that the observed null-result is likely due to an active mechanism. As infants

could not receive instructions, a follow-up study, close to completion, investigates the spontaneous responses of adults in the same paradigm. Data gathering is still ongoing also with 14-month-olds to see if the spontaneous social presence N400 effect identified in adults4 is apparent already at the developmental onset of the N400. Taken together, an entirely new picture of the development of spontaneous and effortful mentalization during linguistic communication is emerging. In the context of a novel research line, we will report new data showing that semantic processing, as reflected by the N400, may be fundamentally mentalistic – and meaning may be computed as an attributed belief.

## PA-030 Five year old children show cooperative preferences for faces with white sclera

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Humans have a unique eye morphology that includes a distinct lack in scleral pigmentation, causing our eyes to be particularly white in comparison to those of other species. It has been hypothesized that this morphology evolved to make it easier to track the gaze of others, facilitating collaborative and cooperative interactions (i.e., the cooperative eye hypothesis). If so, then human children might already display a cooperative preference for faces with eyes that have visible white sclera. Yet although previous research has shown that children for example like stuffed animals with eyes that have white sclera more than stuffed animals with eyes that do not, there has not been a direct empirical assessment of children's cooperative preferences for human faces with white sclera. In three pre-registered online studies (total N= 144, 71 Female), we presented 5 year old children with moving 3D face models in which facial morphology was manipulated. We then asked children to rank order which individuals they most wanted to play a game with, build a puzzle with, and would ask to help them with their jacket (compiled into a cooperation score), and which individual looked the cutest, cuddliest, and which individual they would choose to give a hug (compiled into a cuteness score). They did so 2 times, once for a set of Female faces and once for a set of Male faces. Children found "alien" faces (i.e., blue skin colour) with human eyes more cooperative than faces with dark sclera (Study 2) but not faces with enlarged irises (Study 1). Importantly, for more human-like faces (Study 3) children showed a cooperative preference for faces with human eyes over faces with eyes that had enlarged irises and dark sclera. Moreover, they found faces with enlarged irises cuter (but not more cooperative) than eyes with dark sclera. These results show that (the visibility of) white sclera shapes how children evaluate social partners and thus illustrates the remarkable importance children already ascribe to the discernability of a partner's eye gaze in their judgement of a social partners' cooperativeness. As such, the current studies provide further evidence for the unique role of human eye morphology in human social ontogeny as well as in our species' social evolution.

## PA-031 Social neural correlates in infants at raised likelihood of autism: Links with parent-infant interaction?

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Reduced eye contact and delays in social communication and interaction are among the core symptoms of autism, emerging in behaviour after 12 months of age. However, brain function measures have been able to identify subtle differences in social attention, such as eye gaze and face processing in the first year of life. Differences in the neural basis of social attention have been hypothesized to relate to behavioural social attention, and alter the child's interactions with their caregivers (Elsabbagh & Johnson, 2010; Klin et al., 2020). Here, we examine the relation between brain function and parent-infant interaction (PII) in a prospective cohort of infants with and without a family history of autism. Methods: Using a Structural Equation Modelling approach, we tested whether the amplitude and latency of infant brain responses (Event-related potentials, ERPs) to visual stimuli (P1, P400 and N290) were associated with specific features of PII in a group of 243 8-month-old infants with (at Elevated Likelihood, EL, N=166) and without (Typical Likelihood, TL, N=77) family history of autism. Event-related potential responses to faces with direct gaze vs/or averted gaze/non-faces and to dynamic eye gaze shifts directed toward vs away from the infant were linked with specific aspects of unstructured PII (infant attentiveness to caregiver, parent sensitivity: parent sensitive responsiveness and non-directiveness). The mediating role of infant behavioural attentiveness between brain function and parent sensitivity was also examined. Results: No direct associations were found between the brain measures and parent sensitivity. However, infant behavioural attentiveness to parent was associated with the P1, N290, and P400 components differentially in the EL and TL controls; the relationship between face processing amplitude (P1, N290 and P400 responses to faces with direct vs averted gaze or vs non-faces) and parent sensitivity was significantly mediated by infant attentiveness to parent within play interaction only in the EL group (EL: $\beta = -0.072$, $p = .043$; TL: $\beta = 0.077$, $p = .301$), while faster brain responses to both social and non-social stimuli were linked to greater attentiveness to parent in the TL group (TL: $\beta = -0.32$, $p = .048$, EL: $\beta=0.14$, $p=.301$). Conclusion: These results may reflect diverging neurodevelopmental pathways of visual social attention that relate to social attention within the context of play between the EL and TL groups, specific to the magnitude and the timing of brain response in EL and TL infants, respectively. They provide evidence that infants who are more interactionally attentive to their parent exhibit greater coupling between neural processing of faces and parent sensitivity. Further work employing a longitudinal design is needed to better understand the possible causal mechanisms between brain and caregiver-infant interaction processes leading to autism outcome.

## PA-032 Morpho-syntactic ability is supported by maturation of language-related fiber tracts in preschool children

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A key component to acquire in language development is the ability to process grammatically complex sentences. For this, the acquisition of the morpho-syntactic rule system is fundamental, which forms an intersection between lexical words and syntactic structures. The preschool period is characterized by major behavioral improvement in grammatical knowledge on both sentence and word level with milestones at around 4 years of age. In the adult brain, dorsal and ventral white matter fiber tracts connect the frontal and temporal cortex, and play different functional roles for language processing. Here, we ask which maturational changes in the child's neural language network underlie the emergence of morpho-syntactic ability in the critical preschool years. For this, we reconstructed dorsal and ventral language-related fiber tracts in a sample of 3- to 6-year-old children (N = 90). In a preregistered procedure, we related indices of white matter maturation to children's grammar performance extracted from a standardized test of general language development. For children's ability in morpho-syntactic rule generation, we found no main effect in 3- to 6-year-olds but a significant age interaction for younger (3-y.o.s) versus older (4- to 6-y.o.s) preschoolers in the dorsal and ventral fiber tracts. Additional analyses revealed that the effects in the dorsal fiber tracts were only present in the 4- to 6-year-olds but not the 3-year-olds yet. These results were consistent across several measures for white matter maturation. Our findings show that morpho-syntactic knowledge in preschool children relies on the development of fiber tracts involved in language processes. Further, we found differences between younger and older preschoolers in line with behavioral milestones in grammar acquisition at 4 years of age.



## PA-033 An initial but receding altercentric bias in preverbal infants' memory

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Human infants would seem to face a daunting challenge in selecting what, of all the input coming into their senses, they should attend, encode and remember. As a solution to information selection early in life, when infants are still relatively immobile, infant cognition was proposed to be altercentric (Southgate, 2020), and visual exploration primarily guided by the easily exploitable cues of others' attention. These cues filter the input for the young mind, while having the advantage of highlighting information specific to the environment the infant is born in.

As a test of this hypothesis, we previously showed that when 8-month-olds co-witness with an agent the an object hiding, and then, agent-absent, they witness the re-hiding in a new location, infants misremember the object where the agent has last seen it. In baseline conditions where no agent was present for the hiding of the object in the two locations, infants remembered the ball's actual location. We interpreted this data as support for an altercentric bias, where events witnessed by another agent are remembered better than events encoded in the absence of other agents. Surprisingly, infants showed no evidence that they remembered the object in either location if the co-witnessing agent saw the final hiding location.

In new work, we ran two conditions from our 8-month-old study with 12-month-olds to investigate a) a possible explanation for 8-month-olds' failure to remember the object at its last location when the last location was co-witnessed and b) the presence of an altercentric bias in older infants. In the condition where the agent sees the last but not the first hiding location, where 8-month-olds' evidenced no looking time preference for either hiding location, 12-month-olds noticed the incongruent absence of the object in its actual hiding location. However, in the condition where 8-month-olds misremembered the ball at the first location when it was co-witnessed there, 12-month-olds showed no clear expectation that the ball should be in either place. Older infants thus remember the correct location when the agent also witnesses that hiding event but are less influenced by the agent's presence at only the first event, when subsequently seeing the object transferred to a new location, resulting in no expectations of the object's whereabouts. This series of studies points to an early altercentric bias that likely facilitates information selection, revealed by predictable memory errors, but which wanes by the end of the first year of life.



## PA-034 Mothers' Estimation Errors Regarding Their Infants' Receptive Vocabulary: Effects on Mothers' Verbal Input and Infants' Language Skills

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Infants' language skills are mainly evaluated via indirect measurement tools like parent reports (i.e., Communicative Development Inventory; CDI). Studies using indirect measures showed that infants' language skills are related to the mother's verbal input (Cartmill et al., 2013). Only a few studies have examined how these indirect measures reflect infants' actual language skills. For instance, Read and Reese (2000) showed that mothers from low socioeconomic status (SES) overestimate their infants' word comprehension skills. However, less is known regarding the effect of mothers' estimation errors on their own verbal input to their infants. This study examines low- and high-SES mothers' estimation errors regarding their infants' receptive vocabulary and how these estimations affect maternal verbal input and infants' receptive vocabulary skills.

We examined 34 Turkish-speaking mother-infant dyads from low- and high-SES backgrounds when the infants were 14 months old. Infants' receptive vocabulary skills were assessed via Turkish CDI (Aksu-Koç et al., 2019) as an indirect measurement and the Looking While Listening (Fernald et al.,

2008; LWL) task as a direct measurement by using an eye-tracker for eight words. In the LWL task, infants were presented with one distractor and one target object while they heard the target object's label. We coded looking time at the target and distractor objects. If infants look longer at the target object than at the distractor object, we coded the word as comprehended; otherwise, we coded it as non-comprehended. Then we calculated mothers' under- and over-estimation by comparing maternal reports and infants' LWL performances for these eight words. Underestimation refers to the mother's reporting as "does not comprehend" the related word, although the infant looks longer at the target object. Overestimation refers to the mother's reporting as "comprehends" the related word, although the infant looks longer at the distractor object. We calculated the proportion of overestimation and underestimation with respect to the total of eight words. Lastly, mother-infant dyads participated in free play sessions for 5 minutes to assess mothers' total number of words and the linguistic complexity as the input quantity and quality.

We found no difference between mothers from low- and high-SES for the different types of estimation errors and verbal input quantity and quality (ps>.05). Furthermore, while mothers' overestimations positively predict their total number of words (β=.454, p=.016), mothers' underestimations negatively predict their inputs' linguistic complexity (β=-.584, p=.005). Lastly, mothers' verbal input quality and quantity did not predict infants' overall receptive vocabulary scores.

Our findings corroborate the existing evidence that mothers have estimation errors for their infants' receptive vocabulary (e.g., Bennets et al., 2016), regardless of SES. Moreover, mothers' verbal input for their infants was affected differently by such estimation errors; input quantity was positively by overestimation and quality was negatively by underestimation. Mothers' input might be attuned with their estimations of their infants' language capabilities, which might not align with infants' true capabilities. Therefore, mothers' input might not be related to their infants' vocabulary size since their input might not meet the infants' language learning needs.



## PA-035 Active Control of Learning Enhances Memory Across the Lifespan

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In recent years, research in education and psychology has suggested that giving students the opportunity to exert some degree of independent, active control over the learning experience leads to improved learning outcomes as compared to more passive forms of instruction (Markant et al., 2016; Ruggeri et al., 2019). However, it is still unclear why and under which conditions active learning is beneficial, and how the advantage of active learning emerges at the earliest stages of life.

The current project presents a novel, critical perspective on the rapidly growing literature examining potential benefits of active learning for recognition memory. We review previous work documenting

the effects of active control of study as a learning modality, and trace for the first time the cross-sectional lifespan trajectory of the effects of active control of study on memory from age 5 to 69, by analyzing one set of published data (Ruggeri et al., 2019) together with three new, unpublished sets of data collected from adolescents, younger and older adults, all using the same experimental paradigm. We also tested infants and toddlers between 18 and 36 months of age on a novel gaze-contingent task with a within-subject design. In the task, participants played a simple memory game with the instruction to try to remember (Study phase) and later recognize (Test phase) a set of objects (64 objects for participants aged 5 to 69, 12 objects for toddlers from 18 to 36 months of age). In the Study phase, 5- to 69-year-olds were presented with 16 objects arranges in a 4x4 grid in each of the 4 blocks, and 18- to 36-month-olds were presented with 6 objects in a 2x3 grid in each of the 2 blocks. For half of the materials presented, participants could decide the order and pacing of study (Active condition). For the other half, they passively observed the study decisions of a previous participant (Yoked condition). The Study phase was immediately followed by a Test phase. For 5- to 69-year-olds, 16 objects were again presented in a 4x4 grid with 1 to 15 old objects in each of the 8 test blocks. For 18- to 36-month-olds, the objects were presented in pairs, with one object being completely novel, and the other object from either the active or the passive phase.

We analyzed participants' recognition accuracy, spatial accuracy (for 5- to 69-year-olds) and novelty preference (for 18- to 36-month-olds) as a function of age and condition. We also analyzed the study pattern in the Active condition and its relation to the memory performance. Overall, the results suggest that active learning advantage may emerge already at 18 months of age, reaches adult-like magnitude by age 8 and remains fairly stable throughout the lifespan. Furthermore, our analyses reveal that recognition memory is improved by systematic study patterns, and that this relationship is fairly stable across age groups.

Our study provides novel insights into why and under which conditions active learning is beneficial, and how it emerges at the earliest stages of life.



## PA-036 Improving children's mathematical skills using home-based games

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Children have intuitive knowledge about mathematics even before they are formally taught in school. For example, they have numerical representations of large approximate quantities (e.g., the distinction between 20 and 40) and of small exact quantities (e.g., the distinctions between 1, 2, and 3). They also have geometric representations of large navigable layouts (e.g., the distances and directions of places in the layout) and of the shapes of small objects (e.g., their relative lengths and angles). Can this intuitive knowledge be leveraged to enhance the learning of school-based mathematics? In experiment 1, we trained 6-7-year-old children's intuitive abilities using games that were played at home with their caregiver(s) for 2-3 weeks. Children were randomly assigned to one of three conditions (number, geometry, or no-treatment control) while also equating for age, gender, and time

during the school year. Children in the number condition played two games exercising their intuitive numerical representations, which required them to: a) approximately add and compare large sets of dots in a ratio-dependent manner; and b) relate small numerical magnitudes to positions on a line by establishing one-to-one correspondence relations between shapes and movements on a linear board. Children in the geometry condition played two games exercising their intuitive geometric representations, which required them to: a) find a figure that did not belong with the rest based on a geometric property and b) use small-scale maps to place objects in a larger layout. Children in the no-treatment condition received no games. Before and after training, all children completed tests measuring their intuitive and school-based numerical and geometric skills, administered by condition-masked experimenters. Children who played the geometry games significantly improved in their intuitive and school-based geometry skills as compared with children in the number and no-treatment control conditions. Children who played the number games showed no relative advantage on their intuitive or school-based numerical skills.

What kind of training can improve children's school-based numerical skills? Experiment 2 used a similar home-based training, but focused on 5-6-year-old children's school-based numerical skills directly by aiming to improve their understanding of base-10 compositionality. Similar to experiment 1, children were randomly assigned to either the number or the active control social-cognitive conditions, again equating for age, gender, and time during the school year. Children in the number condition played a board game, which required them to create mappings between grouped dots by tens, spaces on a 5x10 number board, and number words. Children in the social-cognitive condition played a card sorting game, which required them to reason about theory of mind. Children who played the number game significantly improved in their school-based numerical skills compared with children who played the social-cognitive game. All of this research was planned and conducted prior to the onset of the school closures that occurred in response to the COVID-19 pandemic. In light of this crisis, our findings have new relevance, as they show that making educational games available to families in their homes can help foster children's skills at the foundations of learning mathematics.



## PA-037 How differential guidance of attention shapes infants' visual cortical processing

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In the first year of life, infants show a significant development in their ability to selectively attend to objects or events in the environment. This ability has critical importance in early cognitive functioning, since attention is strongly related to memory and learning (Reynolds, 2015). Previous work has shown that social interactions influence infants' attention: when looking at novel objects, infants' neural responses increased following joint attention and eye contact with an adult (Hoehl et al., 2014; Striano et al., 2006; Yu & Smith, 2016). However, it is not yet established whether social interactions

can shape visual processing already in infancy, resulting in cross-cultural differences in children's attention (Senzaki & Shimizu, 2022) and visual perception (Köster et al., 2017) later in development. To better understand this question, our study investigated if differential guidance of attention can shift infants' visual attention to object versus background of a visual scene. To measure infants' visual cortical processing nonverbally, we established in a former study (Köster et al., 2017) that visual processing of object versus background could be assessed in the electroencephalogram of children by using a frequency tagging approach. This is, presenting object and background at different driving frequencies elicits separate evoked responses for each element. In the current electroencephalography (EEG) study, 11- to 12-month-old infants (n = 53) watched flickering natural images with an object in front of a background. Object and background were flickered at different driving frequencies (5.67 and 8.5 Hz, counterbalanced) while infants' visual cortical processing was recorded with EEG. We applied a between-group (object/background), pre-post design with a training phase in between: in the pre- and post-phases, infants observed the scenes. During training, an experimenter guided the infants' attention by consistently pointing either to the object or the background on the scene (according to group) and made a verbal comment in infant-directed speech. In the post-phase, new images were also shown. First, we hypothesised that differential attention guidance will shape infants' visual processing and result in increased evoked responses to the element pointed out. To test this, we will compare changes in evoked responses to object/background from pre-phase to training, as well as from pre- to post-phase between groups. Second, we expected that differential attention guidance will have a lasting effect on infants' visual processing beyond the immediate joint attention interaction (training phase). This could be captured by an enhanced object- or background-focused visual processing (increased evoked responses to the element pointed out) in the post- vs. the pre-phase that generalises to even new post-phase images. In this poster presentation, we will present EEG results to uncover whether differential guidance of attention during a live social interaction can shape infants' perceptual processing in visual cortical networks.



## PA-038 Let's Talk About Causality! Maternal and Paternal Causal Language Input are Associated with Children's Causal Language Production

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Causal language includes different components such as causal connectives, lexical, and morphological causatives, for understanding, interpreting, and lexicalizing events (Ger et al., 2021). Causal conjunctions such as because help us to describe causal events (e.g., Ali did not go to school because he had a stomachache) (Couper-Kuhlen, 1996; Sanders & Spooren, 2009). Lexical causatives involve verbs (e.g., roll, push, cut) that encode both the cause and the effect (Furman et al., 2006; Wolff, 2003). On the other hand, Turkish marks causality also by morphological suffixes (e.g., -dır, -ır, -ar, -ıt) (Aktan-Erciyes & Göksun, 2021; Ger et al., 2021). If someone tries to make someone laugh,

one verb can be used in Turkish (e.g., gül-Dür, 'make someone laugh') to explain cause and effect. Parental causal language affects children's later verb comprehension, causal connectives production, emotional understanding, and reasoning skills (Aktan-Erciyes & Göksun, 2021; Dunn et al., 1991; Van Veen et al., 2009, 2013).

Based on findings in the literature, we expected that causal language input of mothers and fathers can be associated with children's causal language production. Twenty-one mother-father and children (Mage=58.2 months,9 girls) triads participated in the online study (data collection is ongoing). Mother-child and father-child dyads completed story-telling, 5-minute free and guided play with tangram toy with this order. During free-play they were not given specific instructions as how to play with toy. On the other hand, during the guided-play they were given figures to assemble with tangram pieces. We coded causal conjunctions, lexical, and morphological causatives and calculated causal language scores (i.e., total causatives/total clauses) for all tasks. There was no difference in the number of clauses used and causal language used between mothers and fathers ($p>.05$). We conducted partial correlations between paternal–maternal causal language and child causal outcomes controlling for children's age and SES levels. We found that paternal causal language is highly and positively associated with children's causal language ($r=.90, p<.001$). Likewise, maternal causal language is also positively correlated with children's causal language ($r=.57, p=.01$). Paternal lexical causatives are highly and positively associated with children's lexical causatives ($r=.75, p<.001$). Also, paternal morphological causatives are positively related to children's morphological causatives ($r=.68, p=.001$). Maternal lexical causatives are positively related to children's lexical causatives ($r=.62, p<.01$). However, maternal morphological causatives are not associated with children's morphological causatives ($p>.05$).

According to our findings, both maternal and paternal causal language input is associated with children's causal language. Even though mothers and fathers use similar amounts of clauses and causal structures during their interactions with their children, the association between paternal causal input and child causal language is stronger than the association between maternal causal input and child causal language. The reason for this difference may be due to the way mothers and fathers played in guided play session. Although there was no time pressure to assemble the figure they were instructed to complete, mothers completed the figures more quickly compared to fathers. Fathers used a longer time and gave more feedback which included morphological and lexical causatives to the child during guided play task.



## PA-039 12-month-old infants prefer an abstract comforting character in third-party interactions

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A large body of evidence suggests that infants can evaluate pro-social behavior in third-party interactions. One form of pro-social behavior however, namely comforting someone, received much

less attention. The few existing studies paint a mixed picture about the understanding of comforting behavior. While expectations for comforting behavior in third-party interactions have been shown to emerge universally as early as 4 months (Jin et al, 2018), individual differences of such expectations have also been identified in older infants (Johnson et al, 2007; Biro et al, 2015). The current study, using a manual choice paradigm, examined whether 12-month-old infants, after having watched animated abstract characters comfort or ignore a third party in distress, would show a preference for the comforting character. In addition, we investigated the role of animacy cues and infants' self-distress in evaluating comforting behavior.

Infants were presented with two types of animations in which two abstract figures ("parent" and "baby") got separated and the baby figure started to cry. The parent figure then either returned (Comforting) or moved further away (Ignoring). The color and the shape of the parent figure were different for the two types of behavior, see Figure 1. In Experiment 1 (n = 64, 32 female), both figures had eyes, while in Experiment 2 (n = 64, 38 female) they did not. Each animation was repeated four times in alternating order. Following the animations, infants were presented with 3D objects of the parent figures. Infants touching, grabbing or pointing at one of the objects were counted as choice. Color, shape, order of animations and object placement were counterbalanced. Infants' distress during the watching of the animations was coded using a 3-point scale based on vocalization and facial expressions.

In Experiment 1, 47 infants made a valid choice with 32 choosing the Comforting and 15 choosing the Ignoring character, $p = .02$. In Experiment 2, 51 infants made a valid choice with 21 choosing the Comforting and 30 choosing the ignoring character, $p = .26$, see Figure 2. The interaction between the two experiments in terms of the distribution of infants' choice was also significant, $\chi 2 = 7.13$, Fisher's Exact Test $p = .009$, thus infants only in Experiment 1 were more likely to choose the comforting character. Infants' distress ratings did not contribute to the distribution of the choices in either experiments, $B <= -.54$, $SE <= .93$, $Wald <= .34$, $p >= .59$.

We concluded that infants by 12 months of age prefer to see comforting behavior when someone else is in distress and that infants' own self-distress did not prevent them to evaluate the behavior of the characters. A lack of preference in Experiment 2 could be either explained by the necessity of the presence of human surface feature to categorize the abstract characters as animate entities, or by the attention enhancing effect of eyes to process the observed interactions and connect 2D images to 3D objects. Our findings support the idea of an early presence of "moral sense" in infancy.



## PA-040 Young Children are Eager to Take Credit for Prosocial Acts

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Past research on impression management suggests that beginning at age 5, children adjust their behavior according to the reputational demands of the environment. Not only do 5-year-olds engage in more prosocial behavior and less antisocial behavior when they are being observed (Engelmann

et al., 2012), but they are also sensitive to whether in-group or out-group members are watching (Engelmann et al., 2013; Engelmann et al., 2018). What's more, recent work suggests that even 4-year-olds seek to create favorable impressions (Asaba et al., 2022), and will choose to demonstrate competence to an individual who previously saw him/her fail. However, prior to our study, no work had yet explored whether young children will manage their reputations by spontaneously sharing positive information about themselves.

To investigate this idea, we asked whether 4-year-olds (N=60) are more motivated to take credit for actions that are framed as prosocial vs. neutral. In our experiment, children were assigned to either a prosocial or neutral condition. Children were first familiarized with an experimenter and a puppet (Doggie), and after a brief warm up, Doggie went to take a nap. Next, the experimenter motioned towards a pile of paper scraps that Doggie had been using for an art project and requested that the child either "help clean the pieces up for Doggie" (prosocial) or "move the pieces out of our way" (neutral). We looked at tendency to inform with three dependent measures. First, after the scraps had been picked up, Doggie woke up from his nap and appeared before the child, prompting him/her to speak three times (with a six second pause after each prompt), but never mentioning the papers directly. Prompts continued until the child mentioned the papers. After this, doggie left, and a new puppet, Eeyore, mistakenly gave Doggie credit for picking up the papers (again with three interval prompts). If/when the child corrected Eeyore, the prompts ceased. And as a final measure of tendency to inform, we requested the child's parent sit beside him/her and ask: "What did you do during the game?" We recorded the parent-child conversation for up to one minute.

Results were interesting across our three measures. First off, children in the prosocial condition were more likely to inform Doggie that they had picked up the papers before or after the first prompt than children in the neutral condition (figure 1), and they also protested more often when Eeyore gave Doggie credit for cleaning up (figure 2). Additionally, children in the prosocial condition more often told their parents about picking up the papers than those in the neutral condition (figure 3). Altogether, these results suggest that 4-year-olds are aware of the reputational benefits of helping others and are thus more eager to take credit for prosocial vs. neutral actions. And importantly, rather than just responding to the demands of a private vs. public environment, children in our study actively managed their reputations by making a private action known.



## PA-041 Influence of Infant-Directed Speech on Visual Learning and Object-Label Associations in Toddlers – An Online Eye-Tracking Study

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Accumulating evidence indicates that an infant's attention to and learning of language is enhanced by infant-directed speech (IDS; Spinelli et al., 2017). Compared to adult-directed speech (ADS), IDS is characterized by acoustic properties such as a higher mean pitch, higher pitch variation, and a slower, linguistically simpler language (Saint-Georges et al., 2013). In the long run, IDS enhances

early speech processing and later language learning. However, the effects of IDS on other areas of development remain largely unexplored. The current study investigates the influence of IDS on visual attention and learning, combining the study of visual information encoding and word comprehension in two age groups.

Within an eye-tracking paradigm, 12- and 21-month-old infants are presented with two animated novel objects. These are paired with one of four different pretested German-sounding pseudo-words, introduced either in IDS or ADS within short, recorded German sentences (translated example: "Look here, a Baft. Where is the Baft?"). Objects are presented again for 15 seconds in pairs of two, contrasting those accompanied with IDS and ADS. During the first five seconds, preferential looking is evaluated as a criterion for object recognition. For another 10 seconds, the same recorded voice asks the children to search for each object, one at a time. This second phase tests whether children have acquired word-object associations. Sequences are repeated twice with the same set of objects before a second set of word-object pairings is introduced. N = 72 participants are projected for the final analysis. Data collection is planned until November 2022 and data analysis will be finished by December 2022.

Infant looking behavior is employed as a marker for visual encoding and learning of object-label associations. Enhanced learning for object-label pairings presented in IDS is expected in the older age group, as previous research suggests an advantage for learning new IDS labels in 18-21-month-old children (Houston et al., 2012; Ma et al., 2011). Thus, longer looking times towards the correct object are predicted for those items introduced in IDS. Less is known about possible advantages for visual processing in the context of IDS for prelingual infants. Although they are not expected to match visual objects with novel labels, 12-month-olds are assumed to profit from IDS in establishing representations of the presented objects. A novelty preference for the object presented in ADS is expected, as indexed by longer looking times.

It is not only since the Corona pandemic that the use of online platforms for data collection has been on the rise. In order to offer flexibility in terms of time and location in moments of uncertainty, and to examine children in their familiar environment, the study is performed using the online platform Labvanced. This research contributes to the understanding of multisensory processing in early childhood, more specifically of intersensory auditory and visual processing, while making use of online eye-tracking at home.



## PA-042 Parental sound symbolic input at 20-months predicts 4-year-olds' motion event descriptions

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Sound symbolism, the correspondence between speech sounds and meanings, can help children's language development (Imai & Kita, 2014). Sound symbolism is integral to the parent-child interactions (Fernald & Morikawa, 1993) and parents' sound symbolic input is associated with infants' general vo-

cabulary knowledge (Kızıldere et al., 2022). However, to what extent sound symbolism helps language development is controversial (Nielsen & Dingemanse, 2021). Thoroughly investigating parental sound symbolic input with relevant language outcomes might reveal more specific links on the extensive contribution of sound symbolism. In Turkish, a sound symbolically rich language, sound symbolic words mainly refer to manner of motion (i.e., how an action is performed) in adverbs in sentences (Demircan, 1996). Early exposure (e.g., 20 months) to sound symbolic adverbs referring to manner might help children identify event components (path-trajectory of an action- and manner) earlier, facilitating later motion event descriptions (Aktan-Erciyes & Göksun, 2019). Further, the role of sound symbolic input might differ for children at risk of language delays (e.g., preterm children; DeMaster et al., 2019). This study investigated whether (i) parental sound symbolic adverb input was associated with Turkish-speaking children's motion event descriptions and (ii) this association differed for children who are born preterm (PT) and full-term (FT), after controlling for children's verb knowledge. We recruited 60 parent-child dyads when the children were around 20 months (25 PT, Mage=20.04 months, SD=1.34) and followed them at 48 months (Mage=48.64 months, SD=1.70). At 20 months, parent-child dyads participated in a 10-minute free-play session where we coded the sound symbolic input. Each sound symbolic word referring to action (e.g., hop- a circular movement, gıdı- tickle) was coded along with their linguistic unit in the sentence (i.e., noun, adjective, adverb, verb, auxiliary verb). We calculated the total number of words used by the parent in the play session and measured children's verb knowledge via a parental report (TCDI; Aksu-Koç et al., 2019). Around 48 months, children's motion event descriptions were investigated in an online study. Children were shown ten videos depicting different motion events. After watching each video, children described the events in videos, from which we coded path and manner expressions.

After controlling for children's age, being preterm, total words used by the parent, and children's verb knowledge at 20 months, neither overall sound symbolic input (β=.004, p=.979) nor sound symbolic adverb input (β=.184, p=.205) at 20 months predicted children's use of both path and manner at 48 months. However, the interaction between being preterm born and sound symbolic adverb input was significant (β=.536, p=.016), such that the association was significant only for FT children (B=.18, t(53)=2.37, p=.022).

Our results revealed a significant association between sound symbolic adverb input for FT but not PT children's motion event descriptions, indicating that the factors related to PT and FT children's motion event descriptions differ even at four years of age. Our study is the first to demonstrate that language-specific sound symbolic input (i.e., adverb, manner) predicted how children described manner and path, indicating an extensive role of sound symbolism in language development.

## PA-043 Four-year-olds (but not six-year-olds) overestimate shared novel cultural knowledge

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Young children make accurate predictions about the things that other people are likely to know (Aguiar et al., 2012; Cimpian & Scott, 2012), and adjust their knowledge predictions to account for the type of knowledge being predicted (e.g., using knowledge access to predicting shared episodic knowledge, social group memberships to predict shared cultural knowledge; Liberman et al., 2020; Soley, 2019). Despite this early ability to make accurate knowledge predictions, young children also seem especially prone to overestimating who shares their knowledge (Birch & Bloom, 2003, 2004). In fact, examining these kinds of overestimations may highlight the cognitive process that children use to predict shared knowledge. By examining specific overestimation errors when asking young children to predict atypical examples of knowledge (e.g., cultural knowledge that should not by shared by a social group member), we can learn about the process children are using to reason about whether a knowledge item is shared.

The current studies investigate how the type of knowledge being predicted affects how likely children are to overestimate who shares it. In Study 1, 4- and 6-year-olds created two pictures; one picture of a well-known person or story, and one picture of a person or story participants invented during the study. Knowledge of individuals is typically episodic and not shared with strangers, but knowledge of stories is often widely shared among people from the same social groups. Then, we asked participants whether another child from their social groups, who was not present during the study, would know about their person or story. If children recognise that stories are typically widely known by social group members (but not episodic knowledge of people), this may cause children to erroneously predict that another child shares knowledge of their novel story, despite having just invented it. Both 4-year-olds and 6-year-olds predicted that a child who was not present would know their well-known person but would not know their invented person. However, 4-year-olds (but not 6-year-olds) predicted that a child who was not present was equally likely to know about their well-known story and their invented story. Study 2 replicates this finding with another cultural knowledge item (foods), finding that 4-year-olds (but not 6-year-olds) expected a child who was not present to know both a well-known dish and participants' invented dish. Our findings provide evidence that children have intuitions about the kinds of items that are cultural knowledge (e.g., food, stories), and appear to use a knowledge prediction process that assumes cultural knowledge items are widely shared among social group members. We pose that this heuristic caused knowledge overestimations when 4-year-olds predicted how atypical examples of cultural knowledge are shared, and by age 6, children begin to inhibit this initial prediction and consider additional information (e.g., whether the knowledge item is 'typical') when predicting shared cultural knowledge.

## PA-044 Children's partner choice in cooperative and competitive situations

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Choosing the right partners is an essential part of cooperative decision-making, but little is known about the developmental origins of partner choice abilities. In this preregistered study, we investigated cooperative behavior in young children with regards to their choice of partner. Previous research has focused almost exclusively on situations in which the interaction partners available for partner selection differed in terms of their generosity or fairness (for an exception, see Titchener et al., BCCCD 2022). Since most partner choice situations are more complex, we examined the question whether and from what age children are able to adapt their choice of partner to the qualities required by a specific context.

In two experiments, 4-7 year-old children were first familiarized with three potential partners, each of whom were described as possessing one quality in particular: the potential partner was either a very fast runner, very knowledgeable, or a highly generous giver. In a subsequent test phase, children were asked to imagine that they were to participate in three games, all of them in a cooperative and a competitive condition (within-subjects design). Each of the games could capitalize on one of the above-mentioned qualities: we described a speed game, a knowledge quiz game, and a sharing game to the participants. For each game, children were asked to choose a partner from the three potential partners with whom (cooperation) or against whom (competition) they would have liked to play. Experiment 1 (N = 68, 34 girls) and Experiment 2 (N = 120, 60 girls) differed only in the number of partner options in the test phase – children chose between all three potential partners in Experiment 1, and only between two of the previously described three potential partners in Experiment 2. We analyzed participants' decisions as a function of age, condition (cooperative vs competitive) and task type.

We found that children from 6-7 years of age flexibly adapted their partner selections to the requirements of a task. They chose partners with task-relevant skills and qualities (e.g., a smart partner in the quiz game) more often in the cooperative than in the competitive condition; and chose partners who had task-irrelevant qualities (e.g., a smart partner in a speed game) more often in the competitive than the cooperative condition. This flexibility was present regardless of the skill domains in Experiment 1. In Experiment 2, children tended to choose generous partners similarly often in the two conditions, while in the other domains, the difference between conditions was present. Children in the younger age group (4-5 year-olds) in both Experiments chose partners with relevant qualities at chance level in both conditions. This suggests that they did not tailor their partner choices to the specific task requirements.

To summarize, our study found that from 6-7 years of age, young children are able to make flexible and adequate partner choice decisions in cooperative and competitive contexts, and that they treat generosity differently than other skill domains (speed and knowledge). Further research is necessary to explore the background of this difference.

## PA-045 Are children's moral and emotion judgments affected by counterfactual alternatives?

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Counterfactual thinking involves considering better or worse alternatives to events which have already happened. Such alternatives can play a role in changing the moral judgments of events (Markman, Mizoguchi & McMullen, 2008) , as well as making people feel better or worse about reality (Roese, 1994). Although we know that counterfactual alternatives affect adults' moral and emotion judgments, it is an open question when in development counterfactual alternatives start shaping these kinds of judgments. The main aim of this study is examining whether counterfactual alternatives shift preschool age children's moral and emotion judgments. Because children can think counterfactually as early as four years (Nyhout & Ganea, 2019) and children make explicit moral judgments from the age of three (Van de Vondervoort & Hamlin, 2017), we tested children aged between 4 and 6 years. Children (N=31, M=5.26, SD=0.68 years, 16 girls) were assigned to one of three conditions: better alternative, worse alternative or control. Children in each condition first watched a baseline video about an experience of a new child moving from a faraway country. In the baseline video, for example, the new child plays alone in the garden while other children play together. In the two alternative conditions, children then watched a second video showing how the character's experience in the baseline video might have been different. In the worse alternative condition, for example, the other children take toys away from the new child. In the better alternative condition, for example, the other children and the new child all play together. Children in the control condition did not watch an alternative video. All children were then asked the same moral questions (Moral acceptability: Was what happened at the [baseline] school good, just okay, or bad?; Judgment of punishment: Should the children at the [baseline] school be just okay or get in trouble?; Judgment of liking: Do you like the [baseline] school?) and emotion question (Do you feel happy, just okay, or sad about what happened at the [baseline] school?) about the first video to investigate how the availability of counterfactual alternatives affects moral and emotion judgments. We found that children in the worse alternative condition and control condition judged the real events as more morally acceptable than children in the better alternative condition, B = 7.38, p= 0.034, parameter estimate = 1.929, 95% CI [0.214, 3.826] and B = 6.882, p= 0.034, parameter estimate = 1.929, 95% CI [0.214, 3.826], respectively. However, children's judgments of punishment and liking and children's emotion judgments were not affected by the counterfactual alternatives. Further data collection is ongoing. Our results to date suggest that reasoning through alternatives to reality can shift preschool age children's moral judgment. Given that moral judgments play an important role in shaping prosocial behaviours, illuminating when and how children's moral judgments are open to change will guide us in improving children's social relationships.

## PA-046 The effects of visualization and social context of stories on children's creativity

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In contrast to traditional books, digital stories contain several nonverbal multimodal features (visual images, animations, sound effects) but little is known about how these affect the development of children. The visualization hypothesis suggests that cartoons contain readymade images therefore children's fantasy is not used. Additionally, digital stories can be told by a stranger's audio depriving storytelling of its social context. Storytelling is important in both learning and secure parent-child attachment serving as a basis for creativity.

The aim of the study was to explore whether the intensity of visualization (animations, pictures) of a story and the social context of storytelling (parent/stranger's voice) affect children's creativity. We assumed, that stories with more intense visualization are going to be linked to lower scores in creativity as well as stories told by the audio.

We included 6-7 years old children and their parent. Parents were asked about their child's trait creativity, digital media use, and storytelling habits. Creativity was assessed based on the Alternative Uses Test, Figure Association Test, Test for Creative Thinking – Drawing Production (TCT-DP), and a Mental Comparison Task. First, we assessed children's creativity, then they watched or listened to one of two stories on a tablet either red by the parent or the original audio of the cartoon. Stories also varied based on the level of visualization (full animation, pictures only, just text). Finally, we assessed children's creativity again with the same method but with subtle differences in the questions. We videotaped the experiment and analyzed them. Preliminary results are presented and discussed.



## PA-047 Hearts, Flowers, and Fruits: All Children Need to Reveal Their Post-Error Slowing

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Humans tend to slow down in responding after an error. This phenomenon, termed "post-error slowing (PES)", is known well in adults but to a lesser extent in children. Although previous research shows that children as young as 4 years of age show PES, it is unclear whether (1) they show PES in different types of cognitive conflict and differing executive functions demands, (2) whether PES is associated with better task accuracy (percentage correct), and (3) whether children's PES correlates between tasks. Four- to six-year-old children solved the Funny Fruits task (FF; n = 143) – a Stroop-like task – which poses semantic conflict and requires inhibition, and the Hearts and Flowers task (HF; n = 170) which poses spatial conflict and requires inhibition in its incongruent block and both inhibi-

tion and cognitive flexibility in its mixed block. Out of the total samples, 74 children were tested on both FF and HF tasks. We measured the accuracy and reaction time (RT) of trials and calculated PES by subtracting individuals' mean RT of post-correct correct trials from their mean RT of post-error correct trials. Results revealed that (1) children showed PES in both FF ($t(169) = 9.00$, $p < .0001$) and both blocks of HF (flowers: $t(113) = 8.09$, $p < .0001$; mixed: $t(140) = 7.51$, $p < .0001$), indicating that PES occurs in both types of conflict and under varying executive demands. (2) PES was associated with task accuracy, but only for FF ($r(168) = .16$, $p = .04$) and the mixed block of HF ($r(139) = .19$, $p = .01$). (3) PES was correlated only between FF and the mixed block of HF ($r(70) = .24$, $p = .04$). These findings suggest that 4-6-year-old children show PES as an indication of cognitive control, but it appears to be only adaptive for and correlates between semantic inhibition and spatial flexibility.

## PA-048 Inferring mislabeling of unfamiliar objects based on speaker's mental state in infants

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Previously, Southgate, Chevallier & Csibra (2010) found that 17-month-old infants infer the intended referent of a communicator based on her mental state. After seeing two objects hidden into respective boxes, infants saw that a second agent swapped the objects, which was either witnessed (true belief, TB) or not (false belief, FB) by an observer. Then the observer provided a novel label for one of the (hidden) objects and invited the child to give it to her. Significantly more children selected the non-referred box in FB condition, showing that they understood the intended referent was the non-pointed-to object; and raising the question if they inferred that the pointed-at object is not called by that label.

The current study adapted this paradigm to test whether 19-month-old infants can infer a semantic mismatch between an unfamiliar object and a novel label if the labeller has a false belief about what she is labeling. For this, we built on the n400-effect (Kutas & Federmeier, 2011), a negative ERP response approximately 400-600ms after stimulus onset, which is generally larger (more negative) in response to semantically incongruent events such as mislabeling. We probed if infants would show a larger n400 effect in FB than in TB.

Infants were shown unfamiliar objects where an agent picks up the object and puts it in a box. Next, a hand reaches from the side, and replaces the first object with another. This object-swap is either witnessed (TB) or not (FB) by the agent. Finally, the agent points to the closed box, and provides a novel label (a pseudoword), during which we assessed infants' n400 response. To make the stimuli easier to follow, we implemented a blocked design where 6 trials per condition appeared consecutively, and the first block was always TB. Children's vocabulary was also assessed (via parent-report CDI), as we predicted infants' understanding of labelling based on the speaker's mental state may be related to their language development.

At n=32 (of 34 pre-registered) infants there is a consistent but non-significant difference between

conditions, at posterior sites where the n400 effect has been previously found in infants in similar paradigms (Forgács et al., 2020; Kampis et al., 2021), between 400-600ms after word onset (t(31)= 1.8, p= .082, 95% CI [-5.63 .351], M= -2.64μV, SD= 8.3, two-tailed). 23/32 infants show the difference in the predicted direction. Crucially, among those who filled out the CDI, there is a significant correlation between the n400 effect and receptive vocabulary, Pearson's r(22)= -.703, p<.001.
Together, these results suggest that 19-month-old infants may consider a person's mental state when interpreting her communication and infer a semantic mismatch if the person is mistaken about what they are labeling. However, infants show variability in their response and this correlates with their vocabulary. While we cannot make causal claims, speculatively this may reflect that such inferences support word learning in infancy. Our findings also indicate that the n400-effect may not reflect a specific mismatch but can be elicited by something that one infers must be wrong.

## PA-049 Children's Causal Reasoning About Physical Interactions and Causal Language Use for Motion Events

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Reasoning and talking about causal relations are essential for children's early developing cognitive skills (Muentener & Bonawitz, 2017). The force dynamics model of causal language and cognition allows us to investigate children's reasoning about interactions of multiple physical forces on an outcome, involving relations such as enable and prevent (Talmy, 2000). These conceptual categories are encoded by distinct causal verbs in languages (Wolff, 2007). Previous studies show that children struggle with complex causal relations such as when an object's motion is prevented to reach an endpoint (Göksun et al., 2013; George et al., 2019). However, whether children's use of causal language, and specifically causal verbs, relates to their understanding of complex causal interactions of the force dynamics model, has not been previously investigated.
The present study investigates 4-years-old (Mage=48.67 months) Turkish monolingual children's (N=53, 25 females) causal reasoning and causal language. Causal reasoning was measured with an online force dynamics task where children were asked to predict a physical motion outcome under different force configurations (see Figure 1). These were Cause (one force moving an object), Enable (a secondary force promoting the motion), Prevent-180° (an opposing force hindering the motion), and Prevent-90° (a perpendicular force altering the motion). Accurately predicting the distance or the direction of the motion indicated a better reasoning about causal interactions. Causal language was measured by examining children's verbal descriptions about videos of causal events depicting a person acting on objects. Children's use of lexical causal verbs (that are inherently causal; e.g., "break"), and Turkish-specific morphological causal verbs (that are causativized by a suffix; e.g., gül "to laugh" becomes gül-DÜR "to make someone laugh") were coded and scored in terms of their proportion to all verbs used.

Our results from the force dynamics task replicates previous findings showing that children had difficulty with reasoning about configurations where forces were placed perpendicularly on two dimensions. In addition, children's reasoning about these interactions depended on whether they were predicting the distance or the direction of the motion (see Figure 2). Children performed worse in Prevent-90° interactions compared to Cause, Enable, or Prevent-180° relations (ps<.001), and when they were tasked to predict the distance of the motion rather than the direction (p<.001). In causal event descriptions, children used an average of 1.32 verbs for each video. Of those verbs, 56% were lexical causal verbs, 27% were morphological causal verbs, and 17% were non-causal verbs. Moreover, correlations between reasoning in the force dynamics task and children's use of causal verbs indicated that the use of causal vs. non-causal verbs in general had no significant associations (ps>.05). Surprisingly, however, the use of morphological causal verbs was negatively associated with total accuracy in causal predictions, r(53)=-0.380, p=.005.

To conclude, the present study extends previous findings by showing that reasoning about either the distance or the direction matters for understanding force configurations. Furthermore, surprising associations between children's use of causal verbs and reasoning indicates that there are nuanced relations between causal cognition and language.

## PA-050 The effect of emotions on counterfactual thinking in 5 to 7-year-old Children

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Counterfactual thinking (CFT) refers to mental processes which simulate a reality that is counterfactual to the real world. Classic examples for these kinds of thoughts are "what-if" scenarios. CFT has been shown to be closely related to causal thinking and Theory of Mind, but also to emotional evaluation of events. Recent studies found that children perform better at CFT-tasks if these were connected to negative emotions. For example, if children were presented with a story involving negative emotions of the protagonist, they performed better at a following CFT task than if they were presented with a neutral version of the story (Nakamichi et al., 2019). It remains unclear whether counterfactual thinking in young children is particularly supported by negative emotions or by emotions in general. Building on paradigms used by Nakamichi et al. (2019) and Rafetseder & Perner (2018), we examine whether this effect of emotions on CFT shows only in connection to negative emotions or if positive emotions have a similar effect. We present 5 to7-year-old children with three stories containing different emotions and a following CFT-task related to the events in the story. First results will be discussed.

## PA-051 Relationship between multimodal math input, gestational status, and children's expressive vocabulary

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Development of numerical understanding is one of the foundational human cognitive capacities that young children need to develop[1]. Several factors are related to numerical development2 that may range from input- and child-related circumstances. One potential factor that is central to these circumstances is child's gestational status as it has been found to affect linguistic[3] and cognitive development[4]. Here, we investigate the relationship between the quality (speech-only, multimodal) and quantity of math input, parental reports of children's expressive vocabulary, and children's gestational status (preterm, full-term). Previous research showed a strong relationship between input modality during free play between full-term and preterm children's vocabulary development across 14 and 20 months of age[5]. Here, we test this relationship for the quality and quantity of math input that preschoolers receive to see whether they change based on children's gestational status and vocabulary development. Fifty-eight parent-child (24 preterm, 34 full-term; Agerange=24-28 months; Meanage=26.1; SDage=1.36) dyads were participated. Shared book reading was used as a medium of parental math input as it elicits both speech[6,7] and gestural input[8]. The book used in this study (The Very Hungry Caterpillar) consisted of pictured pages of different fruits in several numbers (i.e., one apple, two pears, three plums, four strawberries, five oranges) without written text. Parents were instructed to read the book to their child in the way they would at home. After the experiment, parents completed Turkish Communicative Development Inventory[9] which assessed children's expressive vocabulary. We coded specific math input elicited by parents during book reading session for speech-only and for speech-plus-gesture. Speech-only math input included descriptions when explicit numbers are used to indicate the cardinal number of fruits or for counting. Speech-plus-gesture math input included descriptions when gestures (such as indicating extended fingers that represent numbers or pointing to fruits while counting) are used along with math input in speech. A Repeated Measures ANOVA tested type of math input (speech-only, speech-plus-gesture) as within-subjects factor, gestational status (preterm, full-term) as between-subjects factor, and child's expressive vocabulary score as covariate. Main effects of input type ($F=10.51, p=0.002, \eta2=0.045$), gestational status ($F=10.32, p=0.002, \eta2=0.057$), vocabulary scores ($F=4.42, p=0.040, \eta2=0.024$), and an interaction between input type and gestational status ($F=11.94, p=0.001, \eta2=0.051$) but not between input type and vocabulary scores ($F=2.59, p=0.113, \eta2=0.011$) was found. That is, regardless of their vocabulary scores, full-term children received more math input multimodally (M=0.03, SD=0.02) than preterm children (M=0.02, SD=0.02). However, both groups received speech-only input in similar frequencies (full-term: M=0.02, SD=0.02; preterm: M=0.02, SD=0.02). Moreover, parents' overall math input increased as children's vocabulary scores decreased. In sum, child's gestational status, but not expressive vocabulary, relates to the way parents provide math input to their children as full-term children receive multimodal input more frequently than preterm children. Child's vocabulary development, however, only relates to the amount of input that children receive. These results suggest

that not only overall multimodal input5 and the use of gestures but specific type of multimodal input can be associated with children's gestational status. These underline the importance of considering parental input modality in investigating several other domains of development.

## PA-052 Forcing young children to (pre-)monitor: an experimental approach

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One of the most critical milestones in a child's developmental trajectory is the ability to monitor and regulate their cognitive functions. So-called metacognitive processes serve to monitor behavior and enable adaptive adjustment under varying and continuously changing task demands (Conn, M'Bale & Josyula, 2018; Zimmernan, 2006). Unfortunately, children's metacognitive processes are often inaccurate. Specifically, young children's metacognitive monitoring appears undifferentiated, with young children having difficulties differentiating between correct and incorrect answers (Destan & Roebers, 2015; Lipko, Dunlosky & Merriman, 2009). The question then arises whether they are generally incapable of monitoring accurately or whether, under certain circumstances, they can be supported to monitor more accurately. Previous studies tried to improve children's monitoring, for example, with feedback or monitoring training (Oudman et al., 2021; Nietfeld, Cao & Osborne, 2005). However, the results are inconsistent, and the underlying mechanism remains unanswered (e.g., Geurten & Meulemans, 2017; Lipko et al., 2009).

In the present study, participants solved a paired associates learning task and were randomly assigned to either the experimental group (EG) or the control group (CG). For our EG, we designed a new pre-monitoring approach by forcing children to rate a confidence judgment for every answer alternative prior to selecting an answer in recognition. Additionally, we evaluated a CJ after recognition. The background of the present study are theoretical perspectives on the interplay of memory retrieval, memory monitoring, and strategic decisions about memory performance (Bjork, 1994; Koriat & Goldsmith, 1996). In a metacognitive task, a confidence judgment usually follows after choosing an answer in recognition. According to the theoretical background (the high interrelation of memory and metamemory), a CJ may rely on retrieval processes. Due to immature monitoring processes, the influence of memory traces is strengthened and may boost overconfidence. Our hypotheses were the following: We expected that participating in our EG would increase monitoring accuracy compared to our CG (no pre-monitoring judgment). More precisely, we expected the forced pre-monitoring phase to encourage a comprehensive evaluation of monitoring processes.

We included n = 143 preschool children (M = 5.9, SD = .47) and n = 162 second grade students (M = 7.8, SD = .36). We run a between-subject ANOVA for two different monitoring measures (dependent variables: discrimination score and bias index). The discrimination score is operationalized as the difference between children's average confidence for correct and incorrect answers. The bias index maps a continuous range between underestimation and overestimation. The results for the discrimination score revealed no significant main effect of condition ($F(1,301) = 2.64$, $p = .105$, $\eta p2 = .01$). Turning to

the bias index, results revealed a significant main effect of condition ($F(1,301) = 14.74$, $p < .001$, $\eta p2 = .05$) with less overconfidence in the control group ($M = .30$, $SD = .21$) than in the experimental group ($M = .38$, $SD = .19$). In conclusion, how monitoring processes can be supported remains still unclear. However, our findings contribute new insights indicating that focusing on a differentiated evaluation of answer alternatives may boost overconfidence in young children.

## PA-053 Neural entrainment to gaze-cued visual rhythms in 6-month-olds

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Adults' eye gaze direction guides infants in visually exploring their environment. In this study, we asked how adult gaze direction modulates infant attention to stimuli presented rhythmically in their visual periphery. Specifically, given the evidence that rhythmic visual stimulation can entrain functional brain rhythms, we were interested in whether eye gaze direction would differentially modulate entrainment to rhythms presented in infant theta EEG band (~3-5 Hz), implicated in learning, and alpha EEG band (~5-7 Hz), associated with attention inhibition.

In the experiment, 6-month-olds are presented with a centrally positioned adult female face with direct gaze, with two objects flickering on the left and right side of the face at two different frequencies. The face then turns her gaze to one of the two objects. There are 3 main types of trials: theta, with both peripheral objects flickering within infant theta band (3.43 Hz & 4.5 Hz), alpha, with both objects flickering within infant alpha band (5.54 Hz & 6.55 Hz) and mixed, with one object flickering within infant theta (4.5 Hz) and the other infant alpha (6.55 Hz) frequency band.

Infant steady state visually evoked potentials (SSVEPs) to visual flicker will be used as an index of neural entrainment. We hypothesize that across trial types, SSVEP signal-to-noise ratios (i.e., power at the frequency of interest relative to the power at neighbouring frequencies), will be stronger to the frequencies of objects congruent vs. incongruent with the gaze direction. Moreover, we hypothesise that these effects will be more pronounced for the frequencies within infant theta as compared with the frequencies within infant alpha EEG frequency band, speaking for differential functionality of the two brain rhythms.

The data collection and analysis is currently ongoing ($n = 82$ at present, with the target sample $n = 140$). We will present results of preliminary analyses performed on the data collected so far.

## PA-054 Assessment Battery for Communication (ABaCo): searching for Social (pragmatic) Communication Disorder (SPCD) in the complex world of Special Needs

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Introduction:

The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5 [1]), introduced Social Pragmatic Communication Disorder (SPCD), which is characterised by difficulties in pragmatics. Traditionally pragmatics refers the use of language to convey meanings in a given context [2]. In a multimodal perspective, however, not only linguistic but also extralinguistic and paralinguistic features play a crucial role in communication [3, 4]. A lack of clinical assessment tools, allowing specific differential diagnosis between SPCD and other disorders is documented [5-7]; this absence leds to challenges in the detection of SPCD.

The Assessment Battery for Communication (ABaCo; [8]) is a validated assessment tool for the evaluation of pragmatic abilities, both comprehension and production, through a linguistic, extralinguistic, paralinguistic, contextual and conversational scale. In previous studies, ABaCo has proven to be useful in the detection of pragmatic development in children [9, 10].

This study aims to investigate whether it is possible to identify children with undiagnosed SPCD within the "Bisogni Educativi Speciali" (BES) group, the students with special needs labelled in this way in Italy [11], and whether ABaCo can detect their difficulties. There is no nosographic classification of BES, but this category includes difficulties with school activities.

Materials and Methods:

15 children (7-15 years old) with BES, were recruited from an Italian care centre; exclusion criteria: diagnosis of specific learning disorder or cognitive impairment (QIT<80). A control group of children with typical development was also recruited. The following tests were performed:

- ABaCo [8, 9];
- Children's Communication Checklist, II Edition (CCC-2; [12]);
- WISC IV [13];
- Standard Progressive Matrices [14];
- Some subtests from NEPSY II [15];
- Socio-Economic-Status Questionnaire [16].

Results and Discussion:

A series of independent samples t-test were conducted, to analyse participants' total score on ABaCo. As expected, there was a significant statistical difference between the two groups, with the BES group performing worse ($t(28)=2.69$; $p=.012$).

When analysing the two groups' performance on the comprehension tasks, a difference was found at the edge of statistical significance ($t(28)=2.04$; $p=.050$), while a significant statistical difference was found when considering only the production subtests ($t(28)=2.72$; $p=0.011$). These results suggest

that production is more involved in the overall results than comprehension.
Repeated measures ANOVA and a series of t-tests (Bonferroni correction for multiple comparisons) were performed, to analyse the performance on each scale of ABaCo, and in comprehension and in production. Both analyses revealed a statistically significant difference between the performances of BES and the control subjects on the paralinguistic scale ($t(28)=3.46$; $p=.002$; $t(28)=2.904$; $p=.007$), but not on the other scales of ABaCo.
Performance was also analysed considering the general communication score (GCC) of CCC-2. The analysis (independent samples t-test) revealed no statistically significant differences between BES and controls. In addition, no significant statistical correlation (Pearson) was found between GCC and overall ABaCo scores.
These preliminary results suggest that ABaCo seems to be an effective assessment tool for identifying children with SPCD. However, further studies with larger samples are needed to provide better insights on this topic.

## PA-055 Longitudinal changes in self- and co-regulatory behaviors displayed by parents and children during dyadic interactions: a microanalytic assessment

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During early childhood, there is a constant interaction between individual and dyadic regulatory processes of the child and the caregiver. As children grow older, their self-regulatory capacities increase while the need for co-regulation decreases. These changes are partly due to maturational processes, but also depend on social learning in parent-child interactions. In a multimethod study, 16 parent-child dyads were evaluated when children were aged two or four years, and 18 months later. Measurements at both time points included: (1) parent self-report assessing parental expectations, child self-regulatory strategies in dealing with internal and external challenges, and parental co-regulatory strategies in response to children's behavior; and (2) microanalysis of regulatory behaviors used by parents and children during four different shared tasks. Descriptive analyses show that parents tend to increase their expectations regarding their children's ability to cope with external demands and internal challenges as children get older. There is also a strong increase in the use of negotiation by both children and parents between the ages of 2 and 3.5 years. Microanalytic data analysis reveals significant increases in emotional and motivational child self-regulation between the ages of 2 and 3.5 years, and at the cognitive level between the ages of 4 and 5.5 years. As children grow older, they also become increasingly able to ask for help in regulating their internal states when needed (i.e., calls for coregulation) and to offer co-regulation to their parents at times. Parents show a decrease in co-regulation offered to their children, especially at the cognitive level and between the ages of 2 and 3.5 years. Overall, according to both parent-reported and interaction-coded variables, the longitudinal data suggest a trend towards more horizontal relationships.

## PA-057 Real-time planning of explorative and exploitative actions across development: An exploratory mouse-tracking study

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Goal-directed action is commonly studied in instrumental settings, where agents pursue expected outcomes with certain or probabilistic value. However, humans also assign value to the information they can gain from the world and interact with their environment motivated by opportunities for learning, driven by the urge to constantly improve their world model – a motivational state often termed curiosity. Neuroscientific findings suggest extrinsic and intrinsic value of actions share brain mechanisms and representations. Incorporating these findings with an embodied cognition perspective, all actions can be viewed as decision processes, which show instant preferences for external reward (immediate or delayed) or for learning. It has been suggested that the level of action modulation by curiosity gradually decreases from infancy to adulthood, resulting in less broad exploration (Gopnik, 2017), or otherwise a different balance between specific and diversive curiosity (Bahzydai & Gestermann, 2020). However, curious behavior might also vary as a function of individual cognitive skills (especially executive functions, on top of age differences (Chrysikou, Weber & Thompson-Schill)) and more stable dispositions towards uncertainty and complexity. While the relationship between exploratory behavior and maturation has been studied before (Blanco & Sloutsky, 2021), we aimed to focus on the specific process of planning an exploratory versus an exploitative action, and investigate how these decisions unfold real-time. Furthermore, we aimed to examine how its parameters can be predicted by age and individual differences. In our exploratory study, we examined how 5-7 year-olds, 13-15 year-olds and adults chose between different options to interact with, when these options led either to the attainment of a rewarding goal, to missing information (as a proxy for specific curiosity) or to novel unpredictable stimuli (as a proxy for diversive curiosity). We looked into how the competition between these options was reflected in the real-time action plans; i.e., at the specific hand kinematics while participants made their choices, as we expected an implicit modulation of movement by curiosity in the younger group even when their final choices differed. Participants completed an online decision-making task as we tracked their mouse positions, two stimulus-preference tasks with varying levels of uncertainty and complexity and standard executive functions tasks. Results showed a greater preference for novel stimulation in children compared to the other groups, which replicates previous findings. Furthermore, a mixed-effects analysis on movement parameters revealed differences in the temporal parameters of children's hand kinematics, suggesting greater conflict between reward and novel experiences in children. Adolescents' and adults' movement parameters did not differ as a factor of choice. Complexity preferences, as well as working memory predicted adolescents' curious choices: greater preference for complexity predicted broader exploration (more diversive curiosity choices), while lower WM scores predicted more choices driven by specific curiosity. In total, our results support that school-aged children's preferences for new, unpredictable stimuli can be reflected in their movement. Next steps will focus on the unfolding of these decision processes in time, in an attempt to relate them with learning.

## PA-058 Intergroup bias in minority Arab children's preference for in- vs. out-group informants

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Much of what children know about out-groups is based on other people's testimony rather than personal observation. This information, 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. For instance, children manifest preferences regarding informants based on their expertise and group membership. To date, however, these parameters have not been examined when the information is about people. On the one hand, expertise considerations may guide children to prefer receiving information about a target person, from a member of the target's group. On the other hand, intergroup bias may direct children to prefer their own group's testimony regardless of the target's group membership.

The present research examined whether minority Arab Israeli children are biased regarding their preference for informants. Study 1 served as a baseline study. Sixty-seven children (34 kindergarteners, Mage=5.90 years, and 33 2nd graders, Mage=8.01 years; 45% female) were introduced in three trials to pictures of different places (Park, Mall, and Zoo), and pairs of informant-children who contrasted in their group membership (Arab as in-group, Jew as "conflict" out-group, and Scot as "neutral" out-group). In each trial, children were asked about expertise perception (e.g., "who do you think knows more about the park? Alon, the Jewish boy, or Rafik, the Arab boy?"), and informant preference (e.g., "who do you prefer to tell you information about the park? Alon, the Jewish boy, or Rafik, the Arab boy?"). Results showed that whereas kindergarteners chose an in-group informant as expert and tended not to choose the conflict out-group informant, 2nd graders showed no intergroup bias on expertise judgment. In terms of informant preference, both age groups preferred the in-group and much less the conflict out-group.

Study 2 investigated whether children's responses vary when the information to be obtained is about people whose group membership varies. Here, 65 participants (32 kindergarteners, Mage=5.90 years, and 33 2nd graders, Mage=7.91 years; 54% female) were introduced in five trials to pictures of target-children, and pairs of informant-children, with again having the possibility to choose between one of two informants who contrasted in their group membership, both in terms of expertise and preference. Whereas kindergarteners judged in-group members to be experts both on their in-group and on a conflict out-group, 2nd graders regarded as experts, the respective informant from each target's group. In terms of preferences, again kindergarteners preferred to receive information from an in-group informant both in regard to an in-group and a conflict out-group; 2nd graders also exhibited some bias, preferring to hear from an in-group informant when the target was in-group, and not showing any preference when targets were out-group.

These studies reveal that minority Arab Israeli children manifest intergroup biases regarding informant preferences, especially in regard to information about people. This has important implications regarding how to transmit information to children about groups.

## PA-059 4-6-year-olds' Inter-Group Reciprocity, in the Absence of Negative Inter-Group Biases

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Reciprocity has been suggested to foster social bonds (Ma, Tunney & Ferguson, 2017). From about 5-years-of-age, children demonstrate contingent reciprocity and account for individual attributes of a partner, such as niceness (House et al., 2013), along with social markers such as group membership (Dunham, 2018; Fehr, Bernhard, & Rockenbach, 2008) which guides children's prosocial behavior, either when manipulated minimally or based on 'real' social groups (e.g., race or ethnicity). However, these groups usually involve some pre-existing tension, which inhibits displays of prosociality. The current study addresses members of 'real' social groups who are familiar but not 'hostile', asking whether reciprocal behavior between such groups would have different patterns than 'in-group favoritism' and 'out-group derogation'.

Our Sample consisted of 253 3-6-years-old living in Israel (M=4.8, SD=.73;50% girls), 83 Kindergarten children (Mage=5.6, SD=.47), and 170 preschool children (Mage=4.39, SD=.46). Moreover, 127 children were recruited from a secular educational system and 126 from a religious one. These groups differ by religiousness in their households, and educational settings yet live in one heterogeneous neighborhood and are exposed to one another daily. A 2X2 between participant design included Partner Behavior (egalitarian/selfish) and Partner Group (in/out-group) as independent variables and children's response (egalitarian/selfish) as a dependent variable.

We verified children's awareness of the groups and their group identity. Then, children interacted with an unfamiliar, age and gender-matched partner (via pre-edited video). The partner made a distributive choice which varied between an egalitarian choice (i.e., three stickers for each) or a selfish one (i.e., five stickers for the partner and 1 for the participant). Then, participants chose between the same options but towards the partner.

Two glm models were done per Partner behavior. Towards selfish partners, the model was insignificant over the null hypothesis, as 84% of children responded selfishly regardless of group membership (Fig.1.A). However, towards an egalitarian partner, the model was significant over null ($X2(1)= 4.6$, $p=<.05$; Fig.1.B). Specifically, a 2-way interaction was found between group membership and garden type (i.e., Ks and Pre-Ks). Pre-Ks did not have a preferable response towards benefactors. However, among Ks, only 23% chose the egalitarian response towards in-group benefactors, and 60% did so towards out-group benefactors. Follow-up questions reassured that children evaluated out-group members positively and wished to invite them home (regardless of garden type or group membership). Previous findings with adults demonstrated biases in favor of an out-group (e.g., high-status; Levin, Federico, Sidanius & Rabinowitz, 2002), yet this is unlikely in our case, as both secular and religious children had positive outgroup evaluations. Importantly, Ks' acts of kindness towards out-group benefactors may involve a desire to form inter-group relationships or promote a good reputation of one's group (Engelmann, Herrmann & Tomasello, 2018). Complementary, Ks' acts of selfishness towards in-group benefactors may involve confidence within the relationship and expectations to

have a 'second chance' to repair one's wrongdoing – all of which should be further investigated. The findings will be discussed in light of group dynamics and inter-group relations.

## PA-060 Exploring links between children's ability to reflect on their uncertainty about a claim and their suggestions for how to explore that claim

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Knowing when to be skeptical about a claim and gathering clarifying information about that claim is key to learning and to the development of critical thinking. Prior work on children's selective exploration indicates that their propensity to suggest or engage in targeted and efficient exploration when presented with surprising information increases with age. However, our knowledge of the underlying mechanisms of this development remains elusive.

Informed by prior research on the development of children's metacognitive awareness, this pilot study (data collection ongoing) investigates age related changes in children's uncertainty and uncertainty reasoning and its impact on their decision to seek further information and suggestions for how to do so. Using a between-subject design, we assigned 4-5-year-old children to two conditions (expected N=40): a prompted and an unprompted condition. In each condition, children witnessed a series of four vignettes where an adult presented them with a surprising claim about an object. Children were then asked how certain or uncertain they were that the claim was true. Then, in the prompted condition, children were asked why they felt that way. Finally, in both conditions, children were asked whether they wanted to examine whether the claim is true, and if so, how they would go about doing so.

We predict that: 1) children's expression of uncertainty about a claim will predict their decisions to seek additional information about that claim but not their suggestions for how to explore it, and 2) that children's ability to reason about the cause of their uncertainty about a claim will predict their suggestions for how to explore that claim, more specifically we predict that children who are better at explaining the cause of their skepticism about a claim will suggest more informative exploration strategies. The findings from this study will improve our understanding of how children gradually transition from intuitive science—defined as selective exploration driven by feelings of uncertainty—to more targeted exploration designed to adjudicate between hypotheses derived from reflecting on the causes of one's uncertainty, a more mature form of scientific reasoning.

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## PB-001 Bilingual Education Helps Children to Know "What might have been" Better

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Counterfactual thinking is the ability to think about other possible outcomes and ask "what if" questions after an event has occurred (Harris et al., 1996; Mandel, 2003; Roese & Olson, 1995). Children's counterfactual thinking develops from the age of 3, and their proficiency increases as they get older (German & Nichols, 2003; Gopnik & Walker, 2013; Guajardo & Turley-Ames, 2004). Making an inference from a nonhappening event is related to language skills (Guajardo, & Cartwright, 2016). Therefore, having been exposed to different languages starting from a young age might have consequences for counterfactual thinking. Relatedly, Liu (2018) compared L1-Chinese monolingual vs. L1-Chinese: L2-English bilingual adults for their counterfactual thinking. Results demonstrated that Chinese-English bilinguals had better counterfactual thinking compared to monolinguals. Therefore, the effects of early and intense L2-instruction in the school context on counterfactual thinking worth to be investigating. Overall, the aim of the present study is to investigate how L2 (Second language: English) -dominant vs. L1 (First language: Turkish) -dominant school education influences counterfactual thinking for different age groups of children.

We recruited a total of 153 5-,7- and 9-year-old children attending either L1-dominant schools or L2-dominant schools (89, L1-dominant schools; 64, L2-dominant schools. We administered two counterfactual thinking tasks: The spade story and the vase story (Beck et al., 2010) and PPVT-4 (Peabody Picture Vocabulary Test-4) to assess L2 proficiency. All sessions were recorded and transcribed for coding. We calculated a composite score taking a total of scores of two counterfactual thinking stories. We conducted a 2 (Language Instruction: L1-dominant, L2-dominant) x 3 (Age: 5-,7-, and 9-year-olds) ANCOVA taking counterfactual thinking score as an independent variable controlling L2 proficiency as assessed by PPVT-4. Results indicated that there was a main effect of language instruction and age, $F(1, 146)=7.04$, $p<.01$, $F(2, 146)=19.09$, $p<.001$, respectively. Children from L2-dominant schools had better counterfactual thinking scores compared to children in L1-dominant schools. Nine-year-olds and 7-year-olds had higher scores compared to 5-year-olds, $t(146)=-5.77$, $p<.001$; $t(146)=-4.99$, $p<.01$, respectively. There was no difference between 7- and 9-year-olds ($p>.05$). Besides, there was also a significant interaction between Language Instruction and Age. Results indicated that 5-year-olds in L2-dominant schools performed better than their peers in L1-dominant schools, $t(146)=-4.07$, $p=.001$. Our age-related findings are compatible with the relevant literature. Preschool years are critical for counterfactual thinking development and children get better performance as they age (German & Nichols, 2003; Gopnik & Walker, 2013; Guajardo & Turley-Ames, 2004). There are limited number of studies that compare children that are exposed to different languages at school context in terms of counterfactual thinking. In our study, we showed that children from L2-dominant schools were better in counterfactual thinking abilities compared to children from L1-dominant schools controlling for their L2 proficiency. Our findings are compatible with Liu's (2018) study. Having been exposed to two languages at early ages and switching between the two might have increased the ability to

think about possible worlds. Thus, in the present study, children from L2-dominant schools had better performance on counterfactual thinking.

## PB-002 Does early L2 exposure have an effect on causal verb production? Comparison of 5-, 7- and 9-year-old bilingual and monolingual children

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Causal understanding emerges as early as 6 months of age for contexts including understanding intentional agents and physical contact and extends to social, psychological, and biological causality in time (e.g., Gopnik et al., 2004, Muentener & Bonawitz, 2017). Causal language might be related causal understanding (Ger et al., 2021). However, children's early utterances rarely show causal structures before 4 years of age (e.g, Göksun, Hirsh-Pasek, & Golinkoff, 2010; Kanero et al., 2015). Although causal understanding is widely investigated in literature (e.g., Luo, Kaufman, & Baillargeon, 2009), how specific language input affects children's production of causal language is not addressed extensively (see Aktan-Erciyes & Göksun, 2021). Exposure to an L2 that marks causal structures differently might affect L1 production (Hwang, 2021).

The present study investigates the consequences of early and intense L2 exposure on children's L1 causal verb production as assessed by an experimental causal verb production task. Turkish can mark causality with suffixes that act as transparent cues, whereas English does not.

Five-, seven-, and nine-year-old bilingual (n=77) and monolingual (n=95) children participated in the study in L1-Turkish. Children were instructed to describe 16 video clips they watched on a computer screen to an adult addressee. All video-clips were depicting an actor (only the hand is seen) performing actions with a toy-puppet in a felt playground. Half of the scenes could be expressed with morphological causatives (i.e., make toy-puppet sleep) and the rest half with lexical causatives (i.e., open the door). All lexical causatives were transitive verbs, whereas half of the morphological causatives were transitive (i.e., feed toy-puppet), and the other half were intransitive (i.e., make toy-puppet sit). This constituted our verb category variable (i.e., lexical, morphological/trans, morphological/intrans). All answers were coded into categories based on the verb used (1=lexical, 2=morphological, 3=non-causal) and their accuracy in describing the scene (1=accurate, 2=inaccurate). Responses were further coded as correct when they were accurate lexical verbs for scenes that could be expressed with lexical causatives or accurate morphological verbs for scenes that could be expressed with morphological causatives.

We performed a mixed-effects-logistic regression to predict the correctness of responses. Participants were entered as random effects. Language group (bilingual vs. monolingual), verb category, age group, and the interaction of the latter two were entered as fixed effects. Results yielded no significant effect of language group but a significant interaction between age group and verb category. Tukey-corrected post hoc comparisons showed that for all age groups, lexical verbs were more correctly produced than morphological/intrans verbs. However, only at 7 and 9 years morphological/trans

verbs were used more correctly than morphological/intrans verbs (Figure 1).
Early L2 exposure was not associated with differences in the lexicalization of causal verbs. Children's better performance for lexical causal verbs compared to morphological ones are in line with previous research that morphological causal verbs are produced later in development. An unexpected finding might be that morphological/trans verbs were answered more correctly than morphological/intrans verbs, which indicated that the transitivity of verbs did not complicate the scenes.

## PB-003 Influence of Infant-Directed Speech on Visual Categorization in 4-Month-Olds: An FPVS Study

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At 4 months of age, children are able to categorize human faces at a glance. However, the neural mechanisms behind building distinct categories remain disputed. It has been suggested that the combined information of multisensory input early in life is advantageous to forming categories in context and benefits perceptual development (Bremner et al, 2012; Leleu et al., 2020).
Evidence suggests that maternal odor supports visual categorization performance in children as young as 4 months (Leleu et al., 2020). Whether the stimulation of senses other than the olfactory system also boosts visual categorization remains an open question. The current study focuses on the auditory domain by providing participants with infant- or adult-directed speech during visual stimulation. Beyond the finding that children prefer Infant-directed speech (IDS; ManyBabies Consortium, 2020), research has shown that they benefit from its use in multiple aspects. It has been proposed to facilitate attention, language processing, and language learning in young children (for a review see Spinelli et al., 2017). As neurobehavioral studies suggest, the benefits of IDS may be mediated by specific neural mechanisms, such as facilitated cortical tracking of auditory input (Kalashnikova et al., 2018). Additionally, IDS can serve as an ostensive cue eliciting referential expectations (Parise & Csibra, 2013). As children expect to see a matching social actor when hearing a human voice using IDS, this speech register is assumed to especially benefit the categorization of faces. The social target category of faces holds a unique status in human perception, ever since birth, which is emphasized by studies reporting face-selective neural activity in infants (de Heering & Rossion, 2015).
Fast periodic visual stimulation (FPVS) is employed to investigate the influence of concurrently presented IDS versus ADS on visual categorization. Stimuli are flickered periodically at a fixed rate of F = 6 Hz (6 images per second), while every 6th picture displays a picture of the target category. To compare the categorization of social and non-social categories, faces and cars will serve as targets in a between-subjects design. Target stimuli will be embedded in a randomized stream of highly variable objects. EEG activity at the frequency of stimulus presentation (6 Hz and harmonics) and the categorization frequency (1 Hz and harmonics) will be compared between conditions using Bayes factor repeated-measure ANOVAs. N = 32 participants are projected for the final analysis. Data collection is planned to be finished by November 2022, and data analysis by December 2022.

Beneficial effects of IDS over ADS on visual processing, as compared within subjects, are expected. Moreover, it is anticipated that a social target category is more easily recognized than a non-social one when accompanied by a human voice. Thus, the effect of ameliorated categorization is assumed to be stronger for faces compared to cars as the target category.
This study aims to deepen the knowledge about neural correlates of multisensory processing using an innovative EEG method. It will contribute to the underexplored research on the influence of IDS on general neural processes in infants.

## PB-004 Investigating how infants learn about healthy foods

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Food learning in early life largely relies on social learning (Shutts et al., 2013). Notably, previous research showed that children learn that a food is safe to eat when they directly observe someone else eating that food (DeJesus et al., 2018). However, the impact of other forms of food-related social information on food learning remains largely unknown. One form of social information is food processing (e.g., cutting a carrot), as it indicates that someone has already engaged with a candidate food item. Food processing techniques have been an important part of human food consumption for millennia and often reduce the toxicity of raw foods. In fact, recent work suggests that infants are more willing to approach foods that bear markers of processing compared to unprocessed foods (Rioux & Wertz, 2021). Therefore, the project investigates whether infants view food processing actions as indicators of edibility. Specifically, we are focusing on two types of actions: eating and food processing (i.e., cutting). We are testing whether infants (i) differentially attend to actions that indicate edibility (eating and cutting) compared to a control action and (ii) selectively choose to eat novel foods after observing eating or food processing actions performed with them.
To do so, we are conducting an experiment with 12-month-olds (N = 72, evenly divided into three between-subject conditions) comparing eating, cutting, and touching actions. We use a touch action as the control action because it does not indicate edibility, but is a familiar action for infants who routinely see their caregivers interacting with objects and shares many low-level features with the cutting action. The study begins with an action presentation phase in which infants watch side-by-side video clips. One clip shows an actor performing one type of action on a novel food A (e.g., a purple carrot); the other clip shows the same actor performing a different action on a different novel food B (e.g., a parsnip). The actions are played in alternation and the pairing differs across the three conditions: 1) Eating vs. Touch, 2) Cutting vs. Touch, and 3) Eating vs. Cutting. Infants' gaze is recorded with an eye-tracker to determine (i) the actions they prefer to attend to and (ii) their pupil dilation, which indicates arousal (Mathôt, 2018). After the action presentation phase, infants are presented with the two novel foods shown in the videos and we record which one the infants subsequently

approach and bring to their mouth.
Data collection is ongoing. We predict that infants will (1) exhibit longer looking times and increased pupil dilation when attending the food-relevant actions compared to the control action, and (2) choose the novel food item shown in the food-relevant action videos. In addition, if infants view food processing actions as indicators of edibility, we expect no systematic difference in the Eating vs. Cutting conditions. Our results will shed light on the attentional mechanisms underlying food learning in infancy, and reveal what forms of social information infants use to learn that a novel food is safe to eat.

## PB-005 Reference assignment is dependent on temporal proximity and rarity bias

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In some communicative situations, the referent of an utterance is not always explicitly stated and thus can be ambiguous. If someone says, “look at that!”, one must search for events or objects that are highly relevant to the cognitive environment shared with the communicative partner. This is one of the pragmatics processes of disambiguation, which indicates that communication is not always simply the decoding of signals emitted by others. Humans are biased to attend to rare and/or temporally proximate events. Events that rarely happen are more informative than events that are frequent. Due to the limitations of short-term memory, events are more salient when they occur closer in time to something that attracts attention, such as an utterance. We hypothesized that humans have a “temporal proximity and rarity bias” when they assign an ambiguous utterance to a referent. Our first experiment presented adults with videos in which nine characters appeared in order from left to right and performed specific actions (e.g., throwing a ball, playing a musical instrument, eating food, etc.). Of the nine characters, only one performed something different from the others. Participants were presented six videos in which the odd character was inserted at any point between fourth and nineth spot. Immediately after the last character’s appearance, participants were asked, “Did you see that?” and had to determine which character(s) the speaker was referring to. The Japanese language does not grammatically distinguish between plural and singular forms. Thus, the referent of “that” could potentially mean only one, several, or all characters. We hypothesized that if participants took both temporal proximity and oddity into consideration, the percentage of participants who assigned the odd character would increase as the character was presented later (i.e., closer to the utterance). Results showed that indeed, the percentage of participants who assigned the odd character was largest when the odd character was presented last, and the percentage steadily decreased as the odd stimulus was presented further from the utterance. These results indicate that referent assignment is influenced by the interaction of temporal proximity and rarity. Our second experiment presented the same group of participants with videos in which the utterance was always inserted after the sixth character. In this scenario, one odd character always appeared before the utterance, and another odd character always appeared after the utterance. Participants again showed closeness and rarity

bias. The majority of participants correctly assigned the odd character that appeared before the utterance and did not choose the odd character after the utterance. If participants' attention was merely biased toward odd stimuli, they would have selected both odd stimuli without considering the timing of the utterance. This result rules out that possibility and suggests that they took into account the timing of the utterance when assigning the referent. These findings suggest that the decoding process used by humans to determine referents in communicative environments is biased towards salient events, particularly ones that are rare and temporally proximal, as they are more informative.

## PB-006 Revisiting the relationship between enactment and autistic traits

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Enactment within a Working Memory context refers to physically performing spoken instructions. Previous research has established that typically developing children's memory benefits from physical performance of instructions compared to verbal memory. This has been demonstrated when enactment is employed at encoding as well as the recall phase (e.g. Waterman et al. 2017). This experiment aimed to examine the benefits of enactment in relation to Autistic traits. Previous research comparing children with Autism and neurotypical populations has shown that enactment at encoding may impair performance for children with Autism (e.g. see Wojcik et al., 2011) while enactment at recall may aid performance for children with Autism (Grainger et al., 2017). In the current investigation, eighty one primary school children (6-12 yo) encoded simple action-object phrases by enactment or verbally and were subsequently asked to recall these instructions verbally in serial order. Participants also completed the Autism Spectrum Quotient (ASQ). The main findings showed that overall enactment led to superior memory performance compared to verbal presentation. Furthermore, while Autistic traits negatively predicted performance in the verbal encoding condition, there was no relationship between performance in the enactment encoding condition and scores in the ASQ. This provides indirect evidence that compared to verbal presentation, enactment may help compensate for autism related memory performance deficits in immediate recall. Overall the study provides further support that enactment encoding facilitates memory performance in children and suggests that children scoring high in ASQ may particularly benefit from enacting instructions for to-be-remembered instructions.



## PB-007 Higher-Quality Maternal Feedback is Linked to Children's Communicative Success

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Our daily interactions with communication partners involve the exchange of referents and requests about objects. Describing entities in a way that these can be distinguished from similar others – a part of communicative competence (Küntay et al., 2014) - is defined as referential communication

and develops gradually in preschool ages (Lloyd et al., 1998). Young children's initial referential descriptions are most of the time ambiguous; however, they are able to repair their descriptions after receiving verbal or nonverbal feedback from their communicative partners (Deutsch & Pechmann, 1982). Although there is a rich literature demonstrating the benefits of receiving informative feedback from experimenters in controlled settings (e.g., Coon et al., 1982; Matthews et al., 2012), only one study so far has demonstrated that children improve their descriptions in narratives after receiving clarification requests from their mothers (Carmiol et al., 2018). It remains unknown whether the quality of maternal feedback is related to children's communicative success with others. In this first study investigating the link between mothers' feedback quality and children's referential descriptions, we expected children receiving high-quality feedback from their mothers to provide clearer descriptions when providing descriptions of pictures to the experimenter.

Fifty-six children (34 girls; age range=42-69 months; M(SD)=56.6(6.9)) participated in two referential communication tasks, initially with their mothers and one week later, with the experimenter. In the mother-child task, in each of the 12 trials, children described a target picture among similar and dissimilar distractors to their mothers. Whenever children produced ambiguous descriptions (i.e. failure to produce a description that distinguishes the target picture from others), we coded for the quality of mothers' feedback to their children. Maternal feedback was coded as either (1) ambiguous (e.g., "I can't identify the target") or (2) non-ambiguous (e.g., "Does the girl with the blond hair have a pink dress or a blue dress?"). In the online experimenter-child task with different stimuli, children described target pictures among similar and dissimilar alternatives to the experimenter over 7 trials. We coded for children's ability to (1) form uniquely identifying initial descriptions, and (2) repair ambiguous descriptions. The number of attempts children needed to provide a clear description and the ambiguity of children's descriptions (i.e. number of items children's descriptions correspond to) were calculated to assess how children repair ambiguous descriptions.

Children receiving higher-quality feedback from their mothers provided more uniquely identifying initial descriptions (β=.09, SE=.04, p=.013) and overall, descriptions with lower ambiguity (β=-.08, SE=.04, p=.01) when talking to the experimenter. The number of attempts children needed to provide correct descriptions was not related to maternal feedback.

In sum, we demonstrated that preschool-aged children provide clearer descriptions to their communicative partners if they received high-quality feedback from their mothers after producing ambiguous descriptions. These findings suggest that the quality of caregivers' feedback during communication may have long-term benefits for children's communicative success and aid children in forming descriptions according to the addressee's needs.

## PB-008 Preverbal Infants' Expectations of Others' Helping Behavior

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There has been an impressive body of evidence pointing to early-emerging expectations for others, e.g., at least those from one group, to be helpful to one another (Ting et al., 2020). For instance, 17-month-old infants seem to expect Agent1 to help Agent2, if they belong to one group (i.e., they each say, "I am a bem!" and "I am a bem too!"), different from Agent3 (Jin & Baillargeon, 2017). This, however, seems in contrast to the groundbreaking research by Hamlin and colleagues (Hamlin et al., 2007, 2010, 2011) on infant social evaluation skills. In these studies, after watching Agent1 help Agent2 achieve its goal but Agent3 hinder Agent2, infants either prefer to look at the helper (e.g., at 3m), or choose Agent1 over Agent3 themselves (e.g., at 10m). Importantly, infants in these studies respond similarly to the helping and hindering events, suggesting that they do not hold expectations about these agents' interactions.

There are at least two possible explanations for this discrepancy. One possibility regards the presence of specified group markers in the former study but the absence of them in Hamlin et al.'s work. Further control results from Jin and Baillargeon (2017) provides support for this: When group memberships are unclear (Agents1 and 2 each say, "I saw a bem!" and "I saw a bem too!", but not Agent3), infants no longer expect Agent1 to help Agent2. The other possibility is the involvement of three agents, due to the research questions being addressed, might have been too taxing for young infants (but not to 17m). They thus could not have both reflected on their helping expectations and formulated their evaluations of these agents. The present study investigates the latter possibility by presenting situations with only two agents (A1 and A2), adapted from Jin & Baillargeon (2017), to 5.5-month-olds to examine their helping expectations.

In Experiment1 with a between-subject design, infants (N=24) watched the following. In A1's presence, A2 put facial pieces (eyes, nose, and mouth) of a Hasbro's: Mr. Potato Head, one-byone, into the face of the toy. Next, A2 looked to the only remaining hat piece, out of her reach, and unsuccessfully reached for it twice. A2 then left the scene. Finally, A1 either moved the hat close to A2's original position (help), or even further away (hinder). Infants in the hinder condition (M=26.46 s, SD=12.63) looked reliably longer than those in the help condition (M=15.49 s, SD=5.54), t=2.66, two-tailed p=0.014, suggesting that they expected A1 to help A2.

An ongoing Experiment2 is similar except that A2 shows no need because she does not attempt to reach for the out-of-reach hat piece before leaving the scene. Infants in this control experiment now demonstrate no differential looking times. If these results held, it would provide converging evidence for infant understanding of others' needs in their helping expectations (Köster et al., 2016). Together, these results would suggest that young infants hold helping expectations and can show them in optimal experimental situations, even without group specifications.

## PB-009 I won't lie if you don't like it: Children reduced prosocial lying when lie-recipients disapproved of dishonesty

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Prosocial lies are told for the well-being of others, which makes prosocial lying one type of prosocial behavior (Talwar & Crossman, 2011). Children begin to use prosocial behaviors, however, for self-benefit such as managing their reputations from the age of 5 (Grueneisen & Wareneken, 2022). The present study investigated whether children would adjust their prosocial lying for reputation management. Moreover, this study examined how intuitive thinking (reaching decisions based on automatic processes) influenced prosocial lying.

We conducted the experiment via Zoom with an art-rating task (Fu & Lee, 2007). A total of 59 children aged 4 to 6 (M = 67.1 months, SD = 9.6, 46% girls) participated in the task in two sessions separated by 5 to 7 days. Children rated a drawing both with and without the artist's presence. Prosocial lying was operationalized as giving a higher rating in the presence of the artist (as compared to when the artist was not around), indicating that children told the artist a higher evaluation than what they truly believed. The art-rating tasks used in the two sessions were identical except that in the second session, the artist told the child that she did not like children lying. But in the first session, the artist made no comments about her attitudes to lying. The first session was to record whether children would tell a prosocial lie at a baseline condition. The second session was to study whether children would refrain from telling prosocial lies when the experimenter disapproved of lying. We also measured children's intuitive thinking with the Cognitive Reflection Test for School-Age Children (Young et al., 2018).

Mixed-effects logistic regression was used to analyze how session and intuitive thinking influenced children's decision to tell a prosocial lie. We found that children were less likely to tell prosocial lies in the second session than in the first session (B = -1.17, SE = 0.49, z = -2.41, p = .016, OR = 0.31, 95% CI of OR [0.12, 0.80]), suggesting that children strategically reduced prosocial lying when lying was disapproved of (Figure 1). We also found that intuitive thinking was negatively associated with prosocial lying in children (B = -0.56, SE = 0.24, z = -2.36, p = .018, OR = 0.57, 95% CI of OR [0.36, 0.91]), suggesting that children who think intuitively were more likely to tell the truth across the two sessions (Figure 2).

In conclusion, this study found that children between 4 and 6 years refrained from telling prosocial lies when the lie-recipient disapproved of lying, indicating that children begin to adjust their prosocial lying according to contexts for reputation management purposes from age 4. The results also showed that intuitive thinking was negatively associated with children's decision to lie, suggesting that children who adopt intuitive thinking may emphasize honesty more in prosocial moral dilemmas.

## PB-010 Do babies learn from agents who violate the principles of intuitive physics?

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From the first months of life, infants generate basic expectations about their physical and social environment. This early knowledge is proposed to help infants identifying what to learn and what to ignore. When presented with objects, previous studies have found that seeing events that violate infants' expectations about physics, such as a solid object passing through a solid wall on its path, promotes subsequent learning and exploration. However, when presented with people, studies have found the opposite pattern. Seeing an agent that violates core principles of psychology, such as choosing inefficient actions to obtain a goal, has been found to attenuate infants' learning from the agent. These findings raise the question of why expectancy violations about objects and expectancy violations about people influence learning differently. One critical aspect could be the domain of knowledge in which infants' expectations are violated. Studies manipulating objects' behaviors manipulated violations of intuitive physics, whereas studies manipulating people's actions manipulated violations of intuitive psychology. To investigate the role of the domain of expectancy violation, the present study tested whether seeing an agent who violates core principles of physics influences infants' tendency to learn from the agent. Seventeen- to nineteen-month-old infants (data collection in progress: N = 58; expected = 80) were tested in a between-subjects design in which we manipulated the principle of solidity. Participants saw an agent who either performed a possible action (e.g., passing the arm around a solid wall) or an impossible action (e.g., passing the arm through a solid wall) and then labeled an object. Infants' learning was evaluated in an audiovisual matching paradigm, in which they saw the target object paired with a distractor while either the familiar label or a novel label was played. If infants avoid learning from people who are aberrant in any way, we would expect them to learn the label-object association only in the possible condition. Alternatively, if expectancy violations only attenuate social learning in the domain of intuitive psychology, infants should learn the label-object association both in the possible and in the impossible conditions. The findings of this study will help to better understand how different domains of knowledge guide infants' learning motivations.



## PB-012 Differences in inductive biases alone cannot account for the development of analogical reasoning

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Analogical reasoning is the capacity to reason about abstract relations. The Relational Match-to-Sample task (RMTS) was designed to test this ability (Premack, 1983), asking participants to match

pairs of stimuli that exemplify the same relation; e.g., AA should be matched to BB as both exemplify the relation same; AB should be matched to DE, as both exemplify the relation different. Non-human animals and children younger than 5 typically fail this task (Hochmann et al., 2017). However, they succeed in other abstract matching tasks (e.g. number matching task) and in other relational tasks such as the same/different discrimination task, where they need to respond differently to same and different pairs, suggesting they do possess some representation of the abstract relations same and different.

Two accounts have been offered for these results. First, the infant/animal representations of same and different may not afford success in RMTS, and novel representations must be acquired around the fifth year of life to enable analogical reasoning (Hochmann, 2022). Second, young children may fail at RMTS, not because they lack the proper representations, but because they exhibit an object bias that prevents them from considering relational hypotheses when trying to solve the RMTS (Kroupin & Carey, 2022). The second hypothesis predicts that modifying the inductive bias in favour of relational hypotheses should improve performance in RMTS, even in younger children. The representational hypothesis, in contrast, predicts that modifications of inductive biases should only be effective after the representational change.

In Experiment 1, we first replicated previous findings showing that 3 and 4-year-olds fail at RMTS, while 5- and 6-year-olds succeed (N=24 per age group). In Experiment 2, 3-, 4-, 5- and 6-year-olds (N=24 per age group) were tested on the RMTS after taking a same/different discrimination task aimed at priming the representations of the relations same and different. Results showed that all age groups succeeded at the discrimination task. Four- to six-year-olds succeeded at the RMTS, while 3-year-olds still failed. Moreover, in both experiments, we observed a strong association between knowing the words “same” and “different” (as testified by children’s spontaneous or elicited production of the words at the end of the experimental session), and success in RMTS.

Finally, focusing on the 3 and 4-year-olds tested in Experiment 2, we analysed children who produced the words “same” and “different” (N=17) and those who do not (N=31), separately. Again, both groups succeeded on the discrimination tasks, but only the group that produced the words succeeded at the RMTS. Moreover, in that group only, we observed a positive correlation between performance in the discrimination task and performance in the RMTS.

Overall, the results of Experiment 2 suggest that a modification of inductive biases in favour of relational hypotheses is only effective in children that possess the words “same” and “different”. Thus, differences in inductive biases alone do not account for the development of analogical reasoning. Rather, a representational change signalled (and possibly caused) by the acquisition of the words “same” and “different” appears to be necessary.

## PB-013 Not a pipe: Local assignments between visual symbols and discourse referents in 15-month-old infants

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Human communication often involves local assignments between perceptually available objects (symbols) and fictional or real referents under discussion (discourse referents). This structure is exploited in many communicative media such as pretend play, puppet shows, diagrams, and animations (e.g., a banana standing for a phone, a puppet standing for an agent, etc.). In the current study, we built on the paradigm used in Pomiechowska, Brody, Gliga, & Csibra (2021) to investigate whether 15-month-old infants can set up local assignments between an arbitrary visual symbol and a discourse referent upon labeling the symbol by a familiar noun. In Experiment 1, infants were presented with two different geometric shapes (e.g., a blue triangle and a yellow octagon), one of which received a familiar label while being pointed to (e.g., "Look! A car!" while pointing to the triangle). At test, which immediately followed the labeling phase, infants heard a question involving either the familiar label introduced before (e.g., "Where is the car?"; same-word trials) or a different familiar label (e.g., "Where is the banana?"; different-word trials). Infants' responses to these questions were measured by an eye tracker. We found that, at test, infants looked longer to the object highlighted during labeling in same-word trials relative to different-word trials, indicating that they successfully assigned the arbitrary geometric shape to the description provided by a specific familiar noun. To test for the alternative explanation that infants link the labels to the sets of features highlighted during labeling, in Experiment 2, infants are exposed to identical-looking geometric shapes (e.g., two blue triangles), only one of which is pointed to and labeled. If infants link labels to feature sets, they should look equally to the two shapes in same-word test trials. By contrast, if infants interpret labeling events as connecting particular visual symbols to the referents denoted by the labels, they should look longer at the highlighted object in same-word, but not in the different-word, test trials. Data collection for Experiment 2 is ongoing.



## PB-014 Individual Differences in Infants' Exploration Styles within a novel, gaze-contingent Paradigm

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Infants explore the world to learn about it based on their intrinsically motivated curiosity. However, the cognitive mechanisms underlying such curiosity-driven exploratory behavior remain largely unknown. To shed some light onto this, we designed a novel gaze-contingent eye-tracking paradigm to capture both, general characteristics, and individual differences regarding infants' curiosity-driven, active exploration.

Here, 10-12-month-old infants are introduced to two novel stimulus categories (species of Fribbles, TarrLab). Two identical "houses" are presented on a computer screen, and a new exemplar from either category is revealed when the infant fixates on the corresponding house. This design enables us to distinguish between exploration – switching from one category to the other – and exploitation – consecutively triggering exemplars from the same category. We measured the number, sequence of trigger-events, and the proportion of switch-decisions out of all triggers.

Data from N=62 10-12-month-old infants (Mean age=11.11, SD=0.51, 50.8% female) suggested 4 clusters of exploration styles when including number of triggers, switch-proportion and focus towards either category: "extreme exploiters" (n = 19) triggered many exemplars almost exclusively from one category, whereas "extreme explorers" (n = 7) fully disengaged from the study after only a small number of triggers; often one to each category. Two remaining clusters captured similar, somewhat more balanced exploration styles, where "moderate exploiters" (n = 16) triggered a lower overall number of exemplars focusing more on one of the categories, and a group of possibly "optimal explorers" (n = 20) who triggered overall more exemplars to explore and exploit both categories.

Furthermore, we investigated whether the emerged clusters relate to other demographic characteristics. While older infants were generally more likely to be in the last, arguably optimal, group, gender was only related to the small group of extreme explorers, in that members of this group were more likely to be male. We are also in the process of analyzing infant caregivers' responses to the novel infant curiosity questionnaire and temperament questionnaire which would offer further explanation for the observed exploration types. Together, these findings offer novel insights into the mechanisms of curiosity-driven exploration from early in infancy, highlighting the importance of acknowledging and understanding individual differences.



## PB-015 Where is the car I saw someone hide on the screen? - investigating 18-month-olds understanding of online communication

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Due to the COVID-19 pandemic, interactions via online communication platforms have become ubiquitous in the lives of infants and children. Recent research revealed that toddlers represent screen events as representations that are decoupled from the immediate environment, and thus reject animation-reality crossovers (Revencu & Csibra, 2021). However, understanding online communication would require children to handle it as happening in the here-and-now, and grasping that in the case of online channels, there is a crossover between the screen and reality.

In this current study, we investigate how 18 months old infants reason about the consequences of events observed on a screen may have on off-screen settings. During the experiments, children play a warm-up game with an experimenter (E), during which a bear is hidden in one of two boxes, and

the participants are prompted to search for it. Once they select the correct location at least 3 times, things proceed to the test phase. At this point, children observe a protagonist (P) first hiding a car and then a star in one of two boxes either in the room (Live Condition), on a pre-recorded video (Video Condition) or during an interaction via video chat (Video Chat Condition). After each hiding event, children receive the boxes from E and then P, and are prompted to search. We record if they search for the object at the shown location. Our hypothesis is that the performance of children would be better in the Live and the Video Chat conditions, compared to the Video Condition.

Data collection is still ongoing (n = 43, planned sample = 48). In the Live Condition, children search at the shown location in 61% of the trials. In the Video Chat condition, they do so in 60% of the trials. In the Video Condition, they search there in 29% of the trials. Thus, currently it seems infants make different inferences based on videos shown on a screen and digital interactions that have a contingent manner, allowing us to conclude that young children already understand the specific nature of online platforms being continuous with reality.

Revencu, B., & Csibra, G. (2021). For 19-Month-Olds, What Happens On-Screen Stays On-Screen. Open mind: discoveries in cognitive science, 5, 71–90. https://doi.org/10.1162/opmi_a_00043

## PB-016 Associations Between Mothers' and Children's Curiosity in the Turkish Context

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A Growing body of research suggests that curiosity indicates learning and personal growth (Kashdan, 2004). However, curiosity is not a unified phenomenon. There is a two-dimensional approach to studying children's epistemic curiosity (Litman, 2019). Accordingly, interest type (I-type) curiosity includes children's pleasurable experiences and interest in the unknown, whereas deprivation type (D-type) curiosity includes children's orientation to reduce unpleasant experiences of feeling deprived of knowledge. As in children, adults' curiosity is also a multi-faceted phenomenon (Piotrowski et al., 2014). Despite the growing interest in curiosity literature, there is a scarcity of research exploring the precursors of this construct. Of these precursors, parents' curiosity orientation and the ways they interact with their children are of particular interest in this study. In this exploratory study, we aim to examine the association between parents' and children's curiosity domains, as well as parents' curiosity-promoting behaviors in a joint book reading task.

A total of 108 Turkish mother-child dyads participated in this online study (Mage of mothers = 39.5 years, SDage of mothers = 17.3 months, Mage of children = 60.1 months, SDage of children = 9.54

months, 53.7% girls). Coding is ongoing for an additional sample of 138 children from the US. Turkish mothers completed a set of questionnaires. The I/D Young Children Curiosity Scale (Piotrowski et al., 2014) measured children's interest-type curiosity and deprivation-type curiosity. The Five-Dimensional Curiosity Scale (Kashdan et al., 2018) measured mothers' multi-faceted curiosity including joyous exploration (pure enjoyment of novel stimuli), social curiosity (interest in the lives of others), stress tolerance (managing the distress that arises with unfamiliar stimuli), deprivation sensitivity (the need to resolve a lack of information), and thrill-seeking (passion for adventure). To measure mothers' curiosity-promoting behaviors towards their children, we designed a wordless picture book about the sea adventures of a character (see Figure 1). We asked parents to read the book to their children as they would do at home. We coded mothers' sensitivity and cognitive stimulation levels based on their overall interaction during the joint book reading. Sensitivity included helping their children to have a positive and enjoyable learning experience, and cognitive stimulation referred to as stimulation to encourage children's learning. Zero-order correlations of the study variables are presented in Table 1. Children's interest and deprivation type curiosity was moderately correlated ($r = .611$, $p = .001$). Mothers' joyous exploration was associated with both childrens' interest and deprivation type curiosity ($r = .27$, $p = .006$ and $r = .313$, $p = .002$, respectively). Observational measures of mothers' sensitivity and cognitive stimulation were associated with childrens' interest type curiosity ($r = .258$, $p = .016$ and $r = .225$, $p = .036$, respectively), but not with childrens' deprivation type curiosity. These preliminary associations point out that we not only replicate past work showing that curiosity across the lifespan is a multidimensional construct, but we also extend these findings by showing that parental curiosity-promoting behavior has differential effects on aspects of children's curiosity.



## PB-017 The role of task-context for observational learning in childhood: imitation following non-functional, non-normative and counter-intuitive action demonstrations

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When children see another person modelling an action that is causally irrelevant for achieving a given goal, they quite reliably imitate this action. This phenomenon, called overimitation (OI), has been subject to many studies ever since its discovery (Horner and Whiten, 2005). However, to date, little is known about whether non-functional, non-normative, or unusual action demonstrations elicit imitation in young children to the same extent, and whether age-related changes are similar across different task-settings.

To broaden the perspective on children's high-fidelity imitation, four-to-seven-year-olds (N = 80) took part in three different tasks each. Task 1 (jar-task) resembled a typical OI experiment – a model demonstrated an action sequence, consisting of functional as well as non-functional action steps to retrieve a cookie from a jar. In Task 2 (picture task), participants observed the model coloring a picture of natural objects with wrong (unnatural) colors (e.g. using blue for an apple), thus demon-

strating non-normative behavior. In Task 3 (tower-task), the model expressed the wish to build a high tower out of tissue-bags, but actually placed the bags not on top of each other but rather next to each other, thus displaying counter-intuitive behavior. In contrast to a baseline condition (N = 28), which did not include any demonstration, children in the main study revealed signs of imitation in all three tasks. Results show that the imitation rate was higher when the model demonstrated non-functional actions (jar-task), or non-normative actions (picture-task), compared to counter-intuitive actions (tower-task). In line with the existing literature, a positive age effect was found for the jar-task: the imitation of nun-functional actions increased with age. Interestingly, an opposite effect was observed for the other two tasks where younger children revealed more imitation of non-normative and counter-intuitive actions than older ones did. Results are discussed with regard to how task contexts influence children's high fidelity copying.

## PB-018 The relation between the development of counterfactual thinking and Piagetian conservation

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Conservation experiments are at the heart of Piaget's theory that young children are easily misled by appearances and, therefore, fail to grasp that quantities are unaffected by irrelevant transformations (Piaget, 1952, Piaget & Inhelder, 1974). A seemingly unrelated research program on the development of counterfactual thinking has revealed that young children struggle to be sufficiently conservative when reasoning against known facts (Rafetseder et al., 2013).

In this study, we explore the possibility that the ability for conservation and counterfactual thinking share a common cognitive denominator, which is the ability to reverse an action in one's mind and accurately represent the counterfactual state. We thus investigate whether children's understanding of conservation correlates with their capacity for counterfactual thinking.

In a pilot experiment, N = 10 (6 female) children between 5 and 6 years old (68 - 81 months), completed conservation tasks followed by counterfactual thinking tasks in a single Zoom session. In conservation tasks, children received four conservation problems (liquid, matter, number, and length; see Piaget & Inhelder, 1974). For example, the experimenter showed two rows of an equal number of evenly-spaced quarters, and the child was asked if the number of quarters in the rows is the same or different (pre-transformation question). Next, the experimenter spaced out the quarters of one of the rows and the child was asked the same question again (post-transformation question). Subsequently, children received counterfactual thinking tasks adapted from Rafetseder et al. (2013) with vignettes in which two events (two agents separately painting on canvas) change reality (the canvas changes from blank to painted). First, children received control questions in which they were asked to report the original and current state of reality. Children were then asked counterfactual questions, e.g., "What if Bob had not painted on the canvas? Would the canvas be painted or blank?"

Pilot data analyses indicate no association between children's success on conservation tasks and their counterfactual thinking abilities, r = -.02, p = .96. However, a floor performance on the conservation tasks was observed, presumably because the children were younger than age 7. By contrast, almost all children achieved high scores on the counterfactual thinking task, probably because of the ways in which we simplified Rafetseder et al.'s (2013) original tasks. In a new experiment (data collection ongoing) with N = 48 (24 female) children, we raised the age to 6 to 8 years and used a different measure to test counterfactual thinking, in which have to understand that an object would have remained in its original location if a different event than the actual one would have occurred (Rafetseder et al., 2013). This project will shed light on the question of whether there is a developmental link between solving conservation problems and counterfactual thinking. If so, then this would suggest that the mental "undoing" of transformations in conservation tasks affords counterfactual thinking.

## PB-019 The Association Between Prematurity and Joint Attention during Parent-Toddler Interaction

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Background: Research to date has reported inconsistent findings regarding the association between prematurity and Joint Attention (JA). Some studies have shown no difference in the JA skills of preterm and term-born infants, while others have reported that preterm infants show impaired JA skills. A recent meta-analysis demonstrated that degree of prematurity (i.e., gestational age) might be uniquely associated with different domains of JA (see Mateus et al., 2019, for a meta-analysis). Although toddlers engage in more reciprocal interaction and initiate more JA than infants, no research has investigated the characteristics of JA episodes in preterm- and term-born toddler-parent dyads. First, the present study aims to investigate whether JA characteristics differ in prematurely born toddlers' interaction with their parents compared to their full-term peers' interaction. Specifically, it aims to explore whether the quantity (frequency, duration) and quality (type of JA, who-initiated, who-terminated, who-missed) of JA episodes differ between parent-preterm toddler and parent-term-born toddler dyads examining their interactions with their mothers and fathers separately. This study further investigates whether degree of prematurity is associated with prematurely born toddlers' joint attention skills during the interaction. Methods: 22- to 32-month-old (chronological age) preterm-born (< 37 weeks of gestation, N = 23) and term-born (≥ 37 weeks of gestation; N = 31) toddlers and their cohabiting mothers and fathers participated in the study. JA episodes were observed during five minute free play sessions in a semi-naturalistic lab environment and are being coded microanalytically using Mangold's INTERACT video coding software (Mangold, 2022). Analysis: JA characteristics in preterm- and term-born toddler-parent dyads will be compared using independent samples T-test analyses in SPSS. Also, correlation and multiple linear regression analyses will be computed to investigate the associations between degree of prematurity and JA features. Implications: Findings will help to fill a gap in the literature on the association between preterm birth and JA skills during toddlerhood.

## PB-020 Intuitive Thinking Style Predicts Effectiveness of Indirect Goal Priming on Children's Honesty

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It is important to cultivate honesty in young children. Although numerous studies have explored different techniques to promote children's honesty (for example, Lee et al, 2004; Zhao et al., 2021), none of these studies examined individual differences of accepting these honesty promoting techniques. The current study aims to investigate whether children with an intuitive thinking style are more likely to accept verbal priming and adjust their honest behavior accordingly. We assigned children to different priming conditions and adopted a novel online guessing game to measure children's honesty after priming. Both experiments were pre-registered.

In Experiment 1, ninety 5- and 6-year-old children randomly allocated to three conditions received a prime related either to telling the truth (Positive condition: "Why should a good child tell the truth?"), winning the game (Negative condition: "Why should a good child win the game?"), or liking to read (Neutral condition: "Why should a good child like to read?"). Results showed that children in the Negative condition lied significantly more than those in the Positive and Neutral conditions, and intuitive thinking positively significantly predicted lying frequency in the Negative condition.

In Experiment 2, one hundred thirty-eight 5- and 6-year-olds randomly assigned to three priming conditions were tasked either to compare truth-telling vs lie-telling (Positive condition: "Is it better to tell the truth or to tell lies?"), winning vs losing (Negative condition: "Is it better to win or to lose?") or drawing vs reading (Control condition: "Is it better to draw or to read?"). Results showed that children in the Positive condition told marginally less lies compared to the Control condition, whereas children in the Negative condition told significantly less lies compared to the other conditions. Additionally, intuitive thinking styles significantly predicted children's honesty only in the Positive condition.

These two experiments suggest that indirect goal priming can effectively alter children's honesty, and an individual's intuitive thinking style can predict the effectiveness of this priming. Therefore, our study sheds light on possible underlying mechanisms affecting how children learn to be honest, which could help caregivers explore and design personalized honesty promoting techniques.



## PB-021 Lying over zoom: A longitudinal study of the relation between children's online lying and theory of mind understanding

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Throughout the long history of human beings, social interaction has taken the form of face-to-face almost exclusively. Amidst the advancement of technology and catalyzed by the new pandemic, social interaction occurs more and more via online platforms (e.g., Coursera and Zoom) and has quickly gained popularity across the world (Camilleri & Camilleri, 2021; Peachey, 2017). However, there are

scant studies on how these online platforms/interactions change children's social life, especially in their daily use of lies. The current study thus examined whether children tell lies through online interactions and whether the cognitive mechanisms of online lying are the same as in face-to-face interactions. In doing so, we aimed to provide empirical evidence on the influence of online interactions on young children's social behavior.

The present study used a longitudinal method to test children's online lying, general theory of mind ability (Premack & Woodruff, 1978), and free will belief (Zhao et al., 2021). Three- to six-year-old children participated in the study at two different time points approximately 12 to 16 months apart: 100 children were tested at Time1, and 89 children were tested again at Time 2. Children were required to complete the online honesty paradigm and general theory of mind tasks at both time points, while free will belief was only administered at Time 2. We adapted the novel die-rolling task (Weisel & Shalvi, 2015) for the online honesty paradigm, in which children virtually rolled a die and guessed the number. Thereafter, children displayed their fingers to represent their guesses, while the experimenter pretended not to be able to see by covering her eyes, thereby creating opportunities for children to lie. However, unbeknownst to children, the other experimenter was discretely observing their behavior via a separate device.

Results showed that the lying tendency at two time points was positively and significantly correlated, suggesting that there is continuity in online lying and also confirming the validity of the online honesty paradigm. Inconsistent with previous findings on face-to-face interactions, we found that children with better performance in general theory of mind tasks lied less in online interactions at both Time 1 (B = -0.40, SE = 0.18, z = -2.25, p = .025, OR = 0.67, 95% CI of OR [0.48, 0.95]) and Time 2 (B = -0.38, SE = 0.21, z = -1.79, p = .074, OR = 0.68, 95% CI of OR [0.45, 1.04]). Furthermore, free will belief at Time 2 mediated the effect of general theory of mind performance on lying tendency (b = -0.15, CI = [-0.40, -0.02]) at Time 2.

Taken together, the results indicated that children have the ability and tendency to tell lies through online interactions. However, the cognitive mechanisms underlying online lying show different characteristics. The current study is the first to show that free will belief may contribute to the relation between theory of mind and online lying, specifically via a mediating process.



## PB-022 "Teachers will help me succeed": 11-month-old infants recognize the relationship between teacher and student

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Introduction

Preverbal infants selectively referred to the Informant rather than the Non-Informant based on a variety of ostensive cues in order to acquire information effectively (Bazhydai et al., 2020). However, there is hardly any complete Non-informant in preverbal infants' daily life, and people always observe an adaptive behavior and produce the same or similar behaviors in the future (Csibra & Gergely,

2009). The Non-informant condition can entail overlooking one issue: the transmission of general knowledge or skills between models. With a view to emphasize how preverbal infants comprehend the direction and effectiveness of information delivery, in the current study, preverbal infants are presented with the scenario of one teacher agent helping the student agent go from failure to success. At the receptive side of natural pedagogy, we assumed that preverbal infants lying on rational strategy would recognize the relationship between teacher and student and develop referential expectations even though the student also successfully completes the task.

Methods

To test the hypotheses, we created animated videos in which inhuman agents exchange information with co-dependency of exchanged tones (Tauzin & Gergely, 2021).

Two types of conditions were prepared in the Familiarization phase. 11-month-old infants (N= 21, mean = 343.43days, SD = 11.83) were assigned randomly either into Teaching condition or Pseudo-teaching condition. In the Teaching condition, the student attempted to turn-on the light first but failed. Then the teacher approached and demonstrated how to turn-on the light. The student tried once again and succeeded in turning the light. In contrast, in the Pseudo-teaching condition, the student turned-on the light successfully at first, but after the teacher's demonstration, the student failed in the second attempt. Thus, the difference between the two conditions lies in the correctness of the information conveyed.

In the subsequent Test phase, a novel agent appeared, and a novel experimental task was displayed. The new agent approached the teacher and the student sequentially (counterbalanced between the trails) and made the "hmmm" sound twice, to represent a feeling of wanting help. After a moment's hesitation, the new agent stood still in the middle of the screen for 5 seconds. The infants' looking time from the appearance of the new task was recorded by an eye-tracker (Tobii Pro TX300).

Results & Discussion

Infants in the Teaching condition looked longer at the teacher (M = 0.92s, SD = 0.45) than at the student (M = 0.57s, SD = 0.21) in the Test phase ($t = 2.416$, $p = 0.024$). On the other hand, there was no difference in the Pseudo-teaching condition ($t = -0.156$, $p = 0.878$).

The current results have suggested that preverbal infants are able to distinguish the teacher and the student agent and they are more inclined to seek information from the knowledgeable teacher who can help others succeed. The identification of the direction and correctness of information delivery enabled preverbal infants to recognize the models' relationship in pedagogical context, which provide a new perspective on how infants efficiently screen for daily ostensive cues on the basis of referential expectations.

## PB-023 Do Children Form an Integrated Memory of Objects During a Joint Search with a Partner?

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Our behavior changes according to our memory of what we experienced in the external world. For example, repetitive searches and actions for a target from the same layout form associative memories between the position of the target and the configuration of the distractors, and this gradually shortens reaction time (i.e., the contextual cueing effect, Chun & Jiang, 1998). Moreover, memory also changes when we act together with others. Previous studies with adults show that acting together leads to representations of self's and a partner's tasks, which enhances the memory of objects related to the tasks of both (e.g., Eskenazie et al., 2013). Our recent study found that when a pair of adult participants searched together and acted on a target based on its orientation (e.g., participant A pressed a button when a target was oriented to the left, and participant B pressed a button when a target was to the right), the formation of associative memory was facilitated, resulting in an earlier emergence of the contextual cueing effect (Sakata et al., 2021). Considering evidence that 5-year-olds could represent self's and a partner's tasks, they may also be able to form an integrated memory of objects related to the tasks of self and a partner. Therefore, we hypothesized that a joint search would facilitate the contextual cueing effect in 5- and 6-year-olds. We presented 5- and 6-year-olds with search displays that were arranged repeatedly in the same or in random layouts and measured their reaction time to the target. In Experiment 1, we asked them to search for the target and respond to it based on its orientation either alone (i.e., the single group) or with a parent (i.e., the joint group). The results were that the contextual cueing effect was shown in both the single and joint groups and that there was no significant difference between the groups. However, the exploratory analysis further implied that the contextual cueing effect may have been disrupted in the joint group despite being clearly observed in the single group. As there was a significant correlation between the children and the parents in the joint group, the children in that group might have been encouraged to speed up by the parents' rapid response. In Experiment 2, we examined whether contextual cueing emerges in a joint search situation with a peer. The result showed that the contextual cueing effect was not found. These results suggest that incorporating the self and the partner's tasks into associative memory during a joint search may be difficult for 5- and 6-year-olds, but may develop after these ages.

## PB-024 Effects of speaker familiarity on lexical-semantic processing in monolingual French-learning infants

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Many previous studies regarding infant lexical-semantic development have focused mainly on vocabulary growth (e.g., Dale & Fenson, 1996). However, recent work has shown the importance of the lexical-semantic network in language development (for a review, see Wojcik, 2018). It has also been shown that the maternal voice may facilitate word comprehension in very young infants (Parise & Csibra, 2012). However, little is known about whether the familiarity of a voice alone could influence word processing in the infant brain, or whether voice familiarity in and of itself (in the absence of affective links or visual cues) plays a role in lexical-semantic development.

In this study, we use event-related potential (ERP) technique and a semantic priming paradigm to examine the semantic network of 18 monolingual French-learning infants at 18 months - an age at which evidence for the semantic network is still unsure. We manipulated the familiarity of voices presenting the stimuli to infants, which were pairs of spoken words either from the same or different taxonomic categories. In order to manipulate familiarity, we asked parents to present stories read by one of two possible voices at home, several days before the experiment. All infants heard both related and unrelated word pairs presented by a familiar and an unfamiliar voice. Both the familiar and unfamiliar voices came from individuals whom the infants had never previously interacted with. The N400 is a negative-going ERP component associated with lexical-semantic processing of unrelated word pairs in the semantic priming paradigm. We expected to see greater N400 ERP component for unrelated as opposed to related word pairs presented by the familiar speaker. In our statistical analyses, we found a significant interaction of Familiarity (familiar, unfamiliar), Trial Type (related, unrelated), and Hemisphere (left, right). We observed a significant interaction of Trial Type and Hemisphere for the familiar voice, where the N400 priming component seemed to be stronger over the left than the right hemisphere. We did not find any interactions or main effects for the unfamiliar voice. These results suggest that voice familiarity may facilitate word comprehension in young infants, playing a role in overall lexical-semantic development. This supports previous evidence that familiar voices aid in infant word understanding, expanding upon prior findings regarding the importance of the maternal voice for language learning in young infants. Our preliminary results indicate that even in the absence of social and affective links, voice familiarity can help with word understanding.

## PB-025 Properties underlying infants' reluctance to touch plants: A reanalysis of seven studies

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Plants have played an important role in human life and evolution. They provide food and materials, but some plants can be harmful if ingested or touched. Previous studies have found that infants and toddlers respond differently to plants than other entities, exhibiting selective behavioral avoidance and social learning strategies that allow them to safely interact with plants (for a review see: Wertz, 2019). However, it is not yet known which features infants use to identify an entity as a plant. Here we are beginning to investigate this question by re-analyzing data from seven studies that tested infants' reaching behaviors towards plants compared to other kinds of objects (e.g., Elsner & Wertz, 2019; Rioux & Wertz, 2021; Włodarczyk et al., 2018).

In these studies, objects were placed in front of an infant or toddler and (i) whether the infant or toddler touched the objects and (ii) the latency until they did so was assessed. The stimuli included different exemplars of the following object categories: plants (real and artificial), novel artifacts that shared various shape and color features with plants, familiar human-made artifacts (e.g., spoons), and natural objects (e.g., rocks). Consistent with a plant-selective behavioral avoidance strategy that would protect infants from plant dangers (e.g., toxins, thorns), infants and toddlers were more reluctant to touch plants (both real and artificial) compared to the other object categories.

Here we are combining and re-analyzing the data from seven of these studies (total N = 368; age range = 5.16–47.9 months) to explore which visual properties drive infants' and toddlers' reactions to plants. We are analyzing (A) whether all individual exemplars of the object categories (real plants, artificial plants, novel artifacts, familiar artifacts, natural objects) were touched with the same probability or latency, (B) if the results can be explained by plant-typical properties (e.g., green, leafy, branchy), (C) if other visual properties of the individual object exemplars predict infants' touch probability or latency. Our analyses are ongoing, but to date we found that the predictive value of individual object exemplars varies within the object categories. To ascertain visual properties that could explain this variance, we first analyzed the impact of the plant-typical properties „green", „leafy," and „branchy" on infants' touch behavior within the novel-artifacts, where plant-typical properties varied most. However, although object identity predicted the probability of a novel artifact being touched (all p's < .04), plant-typical properties did not predict touch probability beyond the objects' identity (all p's > .26). Infants' latency to touch novel artifacts was neither predicted by object-identity, nor by the plant-typical properties (all p's > .34). This indicates that further non-obvious visual object properties must account for the variance within touch behavior.

Currently, we are compiling a catalog of individual object properties. Low-level visual properties of the object images are being assessed computationally (e.g., contrast, fractality), and mid-level properties are being assessed by adult raters (e.g., symmetry, curvature, complexity). From these properties, we plan to identify specific visual properties that predict infants' and toddlers' behaviors toward plants.

## PB-026 Do pedagogical questions promote infants' inquisitiveness and learning?

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Infants use various behaviors (e.g. vocalizations, pointing) that elicit information transfer from adults. These information-seeking behaviors signal exact moments of preparedness to learn and their use increases if infants receive informative responses from competent and reliable social partners. However, it is unclear whether specific characteristics of adults' responses foster infants' inquisitiveness, and which are the adaptations that make information transfer most efficient. While pedagogical cues (eye-gaze, motherese) have been argued to serve such a function, oftentimes information transfer is preceded by a pedagogical question (question asked by a knowledgeable individual whose goal is teaching). Are such questions an artifact or an adaptation serving efficient learning?

We investigated whether responding to 12- and 18-month-olds' information-seeking behaviors with pedagogical questions, before providing information, fosters learning and increases the frequency of pointing across 8 trials. In the Experimental Condition after an object "magically" appeared behind the experimenter and infants could point, the experimenter asked two pedagogical questions ("Do you know what this is? Do you know what this is for?") before demonstrating the object's function. In the Control Condition the function demonstration was preceded by an affirmative sentence containing episodic information ("Here it is! I found this in the cupboard yesterday!"). We compared how often infants pointed across trials and how many functions they reproduced in a subsequent test phase.

18-month-olds (PedQ N=30, Control N=30) were equally likely to point in the first trial (chi-square(1)=.138,p=.71), in the two conditions, before receiving any feedback. To examine whether the experimenter's feedback modulated subsequent pointing frequency, we fitted a Generalized Logistic Mixed Effects Model with Pointing as the dependent variable, Condition, Trial number and their Interaction as fixed effects and infant ID as a random effect. Results showed a main effect of Condition (z=2.211,p=.027), suggesting that infants pointed more in the Experimental compared to the Control Condition and a main effect of Trial number (z=2.609,p=.009), suggesting that as trials progressed, infants pointed more often. To examine the number of reproduced functions in the two Conditions, we fitted a Generalized Logistic Mixed Effects Model with Function Reproduction as the dependent variable, Condition, Pointing and their Interaction as fixed effects and infant ID as a random effect. No main effect of interaction was found.

Results for the 12-month-olds (PedQ N=30, Control N=30) showed no effect of Condition or Trial number on pointing frequency. Regarding Function Reproduction, the model showed a main effect of Pointing (z= 2.23,p=.02), suggesting that infants are more likely to reproduce the object's function if they have previously pointed, and a Pointing*Condition Interaction (z= -0.94,p=.04), supporting the idea that pedagogical questions are effective for promoting learning, but only when infants may not be fully focused on the new information provided to them, i.e. on trials in which they have not pointed. In contrast, when they have actively requested new information themselves through pointing, encoding is likely optimal and cannot be further enhanced.

These patterns suggest that pedagogical questions play an important role on infants' inquisitiveness and learning, but they appear having a different effect at different developmental stages.

## PB-027 Neural oscillatory dynamics of building novel visual object representations in 6-10-month-old infants

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In adults, oscillations in the Theta- and Gamma-band aid memory formation and object perception. Specifically, Theta-Gamma Phase-Amplitude coupling is suggested to help bind information into a coherent memory representation. Although theta and gamma neural oscillations are one of the major themes in neuroscience in the past decades, we are just beginning to understand how and when the oscillatory landscape develops during infancy and early childhood. Moreover, we are yet to characterize more specifically the oscillatory mechanisms that play a role in early cognitive development. There is growing evidence pinpointing the role of theta in learning and memory, and on the role of gamma in object processing across different stages of development. Yet, we still do not know their specific function in early brain development and how the two act together. One prominent mechanism of forming novel associations in the adult brain is theta-gamma phase-amplitude coupling, which has not been investigated in infants so far.

To start bridging this gap, the current study recorded 27-channel electroencephalography (EEG) from 6 to 10-month-old infants looking at novel and familiar objects in a simple task, designed to capture the process of forming a novel object representation. 47 infants were presented a set of 128 object images in four blocks. A block consisted of a familiarization and a test phase. In the familiarization phase, four object images (one per category) were presented three times each, in a random order. In the test phase of each block, infants viewed the familiar stimuli (seven times each) intermixed with 28 novel objects. Each novel object was only presented once.

We expected increased theta power for novel, in contrast to familiar objects, reflecting the formation of new object representations. With each repeated presentation of an initially novel object, the infants build and refine their neural representation. Thus, we expected trial-by-trial (3 - 8 Hz) theta to familiar objects to decline with each additional repetition. Finally, novel objects should lead to higher theta-gamma amplitude coupling then familiar objects.

Contrary to our hypotheses, preliminary results suggest increased Theta (3 – 5 Hz) and Gamma (30 – 80 Hz) for familiar (repeated) items vs. new objects. A trial-by-trial analysis of Theta dynamics is ongoing. We will further adjust algorithms to remove micro-saccades from the infants' EEG and look at theta gamma coupling during the formation of novel object representations. We will present and discuss the results of the ongoing analyses with respect to the hypotheses.

The study could help advance our understanding of infant object representation and bridge an important gap (theta-gamma coupling) between developmental and adult cognitive neuroscience results, suggesting a not only phylogenetically but also ontogenetically preserved mechanism.

## PB-028 Mechanisms of early causal reasoning: relating infants' neural activity to the accuracy of their predictive saccades

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Identifying causes, by distinguishing spurious correlations from unconfounded evidence, is a challenge in everyday reasoning as well as fundamental to the scientific process. Children have been shown to be sensitive to confounded information, and to actively design interventions to disambiguate causal structures (e.g. Cook et al., 2011). Can infants distinguish situations in which the data they are about to observe is confounded or not? How does infants' recognition of causally relevant information relate to their success in correctly inferring a causal structure?

We addressed these questions by first familiarising infants with a causal structure and a sorting rule. Infants are then presented with situations in which a function of a novel object can either be discovered, or cannot be discovered, because of confounding evidence. We investigated whether infants distinguish between these scenarios and selectively anticipate information in situations where the information is unconfounded. We did this by measuring their neural activity, specifically EEG theta oscillations, which have previously been shown to be involved in infant learning (Begus et al., 2015) and to reflect infants' anticipation of receiving information (Begus et al., 2016). In addition to assessing infants' sensitivity to confounded information, we were interested in behavioural markers that would evidence infants' understanding of the presented causal structure. To do this, we concurrently recorded eyetracking data (in half of the sample) and investigated whether infants would make correct anticipatory saccades in situations where they received unconfounded information and could therefore infer the causal role of a novel object.

EEG theta oscillations (3-5Hz), recorded during the period of the trial in which infants can anticipate receiving either confounded or unconfounded information, revealed that 15-17-month-old infants (N=66) distinguish between the two types of (expected) information. As hypothesized, a higher amplitude of theta oscillatory activity was recorded in trials in which infants could expect causally relevant information, compared to trials in which the information was confounded ($F(64,1)=8.585$, $p=0.005$, $\mu p2=0.118$). Crucially, we related infants' sensitivity to confounded and causally relevant information, reflected in differences in theta activity, to their success in inferring the causal structure, as evidenced in the accuracy of their predictive saccades. We used concurrently recorded eyetracking data from a subset of the sample (N=32), to distinguish infants who correctly predicted the functional role of the novel object in more than 50% of the trials (N=15), from those who did not (N=17). Infants, who on average made correct predictive saccades, showed greater sensitivity to confounded information, compared to infants who did not make correct predictions ($F(30,1)=4.556$, $p=0.041$, $\mu p2=0.132$). Finally, control measures and analyses suggest infants' predictions cannot be explained by a low-level matching mechanism.

This data supports the hypothesis that sensitivity to confounded information, or the ability to recognise and selectively prepare for encoding causally relevant information, may be a necessary condition for correctly inferring causal structures and relationships.

## PB-029 Social Exclusion Affects Over-imitation Behavior in Preschool-aged Children

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Social exclusion, defined as the experience of being kept apart from others physically or emotionally, has significant effects on cognitive, affective, and behavioral processes throughout the lifespan. Existing literature demonstrated that social exclusion increases children's imitative behaviors, possibly reflecting their underlying need for re-affiliation. Yet only few studies investigated how social exclusion modulates the processing of social information early in life. In particular, research never focused on the consequences of social exclusion on over-imitation, the imitation of perceivably causally unnecessary actions in relation to the goal of an action sequence performed by a model. The aim of the current study is to investigate whether first-person experiences of social exclusion can modulate imitative behaviors in preschool-aged children. A sample of 3- (N= 33) and 5-year-old children (N= 42) participated in a live version of the ball-tossing game known as Cyberball (Williams et al., 2000) in which participants were either included or excluded. Children were video-recorded during the Cyberball task to assess whether their behavioral reactions were affected by the experimental manipulation. Then they took part in an over-imitation task (Horner & Whiten, 2005), where they observed a model performing a series of causally relevant and irrelevant action elements within two possible goal-directed action sequences (i.e., retrieving an object inside a transparent box using two alternative methods). Children's behaviors were scored to obtain an index of their efficiency in attaining the goal of the observed action sequence (i.e., irrelevance index). Preliminary analyses were performed by conducting a three-way ANOVA on irrelevant index scores, with Condition (exclusion, inclusion), Age (3-year-olds, 5-year-olds), and Method (A, B) as between-subjects factors. Results revealed a significant Condition by Age interaction (p=.006). Post-hoc comparisons indicated that excluded 3-year-olds (M = 4.52; SD=4,685) were significantly more likely to over-imitate the observed actions than included 3-year-olds (M = 2.78; SD= 4,858, p= .029). Furthermore, excluded 3-year-olds were also significantly more likely to over-imitate compared to excluded 5-year-olds (M = 2.90; SD=4,21, p=.030). The current findings demonstrate that social exclusion differently affects children's imitative responses across the preschool years and extend recent evidence suggesting that social exclusion stimulates a desire for re-affiliation early in life. Further, we expect the effect of social exclusion/inclusion on over-imitation performance to be related to individual differences in social motivation and cognitive functions. Thus, data on children's behavioral reactions during the Cyberball, as well as their temperamental traits and executive functions will be considered when performing the analyses on the full sample. Overall, the implications of the current findings for our understanding of the developmental and social factors influencing imitative behaviors in the first years of life will be discussed.

## PB-030 Consequences of motor development on spatial cognition in infants

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Motor development has critical consequences on perception in infants, including action understanding, mental rotation, and depth perception.

However, we know little about infants' spatial navigational ability and how it may be related to motor development. Spatial abilities have been documented to undergo critical developments from the ages of 3 to 10 years where infants begin to use inertial information, geometric cues, and proximal and distal landmarks to code spatial information. Our proposed research aims to study the links between infants' motor skills and early spatial navigation around the age of 10 months, along with understanding its neural underpinnings using functional magnetic resonance imaging (fMRI) and diffusion tensor imaging (DTI).

We will study the motor capacities of infants with the help of age specific tasks from the Bayley's scale. We will test spatial cognition in infants with a spatial navigation task in virtual reality (VR) inspired by a water maze. In this spatial navigation task, infants are familiarized to a virtual room and an experimental platform with 5 identical covered locations, equidistant from each other, and are presented an attractive reward at 1 out of the 5 locations. Once the infants are familiarized to the marked locations and their landmarks, the virtual room, along with the landmarks, is rotated. The infant's search behavior is then tested with regard to the landmarks to covered locations on the experimental platform, and their navigational pattern within the VR environment is tracked. In a separate MRI session, we will also assess the functional and structural connectivity between our main regions of interests, as stated above. We expect an effect of motor development on spatial navigational abilities in infants, and that this ability is mediated by early brain development in the motor cortex, hippocampal formation and the vestibular system and the connectivity within these regions. The study is currently initiated and is in the early stages of data assessment. We will present the behavioral data of the first ~10 participants with regard to the hypotheses and discuss our findings on spatial navigation in infants with respect to the potential underlying hippocampal, motor, and vestibular development.

## PB-031 Six- and nine- but not three-month-old infants follow the gaze of a humanoid robotic talking head

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Learning to follow others' gaze is crucial for referential communication and infant language development (Senju & Johnson, 2009; Mundy et al., 2007). Infants first follow adults' gaze around 6 months, when preceded by ostensive cues such as direct eye contact or infant-directed speech (Senju & Csibra, 2008). However, infants do not follow only humans' gaze, but also of other intentional agents such as robots that display face-like features and contingent reactivity (Johnson, Slaughter, & Carey, 1998). Previous screen-based studies comparing human vs. robot gaze-following in infants have shown that 12-months-olds follow the gaze of both human and robotic agents, but show subsequent preferential-looking only to the objects gazed by humans (Okumura et al., 2013; 2015). Here, we explore gaze-following skills and subsequent preferential-looking and manual choice to the target object in a real and contingent robot-infant interaction, at the younger ages of 3, 6 and 9 months. To enhance the naturalistic nature of the interaction, we used a "Furhat robot", designed to seem human-like and act as a social agent (a 3D lamp avatar with a back-projected face texture, that orients towards the infant and speaks naturally, escaping the Mona Lisa effect: Al Moubayed et al., 2012). Infants (N=60) sat on their parents' laps, facing the robot placed on a table with similar-sized toys at each side (see Figure 1). In the first phase, the robot made eye contact and oriented towards the infant, greeted in infant-directed speech, and silently gazed at the target object for 5 seconds before gazing back at the infant (6 trials, ABABBA). The second phase was a preferential-looking test to the two objects in the absence of the robot (30 sec), and the third phase a manual choice test (experimenter prompting the infant to grab an object). Results from the 3-month-olds showed no evidence of gaze following in first look or looking time measures (ps > .1). In contrast, 6- and 9-month-olds did show more first looks towards the gazed object ($\beta$ = -.977, z = -2.81, p < .01; $\beta$ = -.69, z = -2.33, p < .02) and longer looking to gazed object in the 6-months group ($\beta$ = -739, t = -.47, p < .01; while at 9 months $\beta$ = -611, t = -2.01, p = .09; see Figure 2). The test phase yielded no significant differences in either group (ps > .1), although 6- and 9-month-olds tended to pick the target object more often than distractor (p = .05, p=.08 respectively). These preliminary results suggest that infants can follow the gaze of a social robot from 6 months of age, similar to prior screen-based studies in human gaze following (Senju & Csibra, 2008), albeit not yet showing robust evidence of further processing of the object (preferential-looking test). These results lay a solid foundation for follow-up studies that further explore more complex infant-robot language learning interactions.

## PB-032 Development of Behavioral Self-Regulation in At-Risk Families: The Role of Family Resources

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The development of self-regulation marks an essential developmental milestone in early child development. Self-regulation was found to be a strong indicator for later academic achievement and socio-emotional well-being (for a review, see Robson, Allen & Howard, 2020). Research suggests that children from at-risk families are at greater risk for developing self-regulation difficulties (Berry et al., 2022; Sektnan et al., 2010; Wanless et al., 2011). Empirical evidence has shown that contextual and social processes shape behavioral self-regulation. However, behavioral self-regulation development within an adversity developmental context is not well understood. Different cross-sectional studies suggest that socioeconomic status (SES), ethnic background, maternal education, family income, and social network may all have an effect on behavioral regulation development. However, across different studies these resources have been mostly examined separately but rarely analyzed together. Thus, the relative importance of these resources in early childhood remains unclear. To address this gap, the present study investigates different family resources in a comprehensive analysis. More precisely, economic, cultural, and social resources were examined in an at-risk sample of 261 children with a high migration background (73%). Economic resources were measured through household income. Cultural resources were measured through maternal education and maternal language proficiency in the official language. Social resources were measured through social activities and the availability of help in child-rearing. Behavioral self-regulation was measured by the Head-Toes-Knees-Shoulders task (HTKS), which taps into cognitive abilities such as attentional or cognitive flexibility, working memory, and inhibitory control (McClelland, 2014; Ponitz et al., 2009). Our hypotheses were the following: We expected positive associations between each family resource in early childhood (age 3) with behavioral self-regulation in the first year of Kindergarten (age 5). Hierarchical regression analyses were computed to examine the impact of the different predictors. The results showed that each resource type positively relates to behavioral self-regulation in Kindergarten. The full-model revealed that household income ($\beta = .20$, $p < .01$), maternal education ($\beta = .18$, $p < 01$) and availability of help in child rearing ($\beta = .12$, $p < .05$) were the strongest predictors for behavioral self-regulation in Kindergarten. Overall, the model explained 13% of the variance. Results suggest that beyond the most studied resource type, i.e., household income, cultural and social resources within the family may play a meaningful role in at-risk children's self-regulation development. These findings may lay the first empirical foundation to adjust policies to implement science-based, high-quality interventions for children to attain their full developmental potential.

## PB-033 Cross-Cultural Comparison of Children's and Adults' Resource Allocation Decisions in Complex Situations

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Around age 4-5, children consider equal distribution as a fair resource allocation. Yet, with age, they move from equality to equity, and take into account factors like a character's need or merit. However, little is known about how children allocate resources in complex situations in which more than one factor has to be considered and whether how children weigh several factors varies across cultures. Concerns for need might be universal across cultures as need is often salient and potentially vital and thus evolutionary relevant. Concerns for merit may vary cross-culturally as people living in cultures with individualistic characteristics may consider merit more than people living in cultures with collectivistic characteristics. Since adults comprise the majority of society and are living in the society longer, their decisions reflect the cultural norms that children have to acquire. The current study examines adults' and children's allocation decisions when need and merit are pitted against each other. German (N = 95) and Turkish (N = 226) adults as well as German (N = 107) and Turkish (N = 92) 5- to 8-year-old children, were asked to distribute resources between two characters in a complex resource allocation situation: One character was hardworking and not needy, and the other was lazy and needy. Additionally, participants allocated resources in two baseline conditions where only one factor varied between the characters: need (needy vs. non-needy) and merit (hard-working vs. lazy). Results show that when children and adults distribute resources in baseline need, regardless of culture, both adults and 5-to-8-year-old children distributed more resources to the needy character. Furthermore, culture influenced resource allocation in baseline merit such that German children and adults allocated significantly more resources to the hardworking character compared to Turkish children and adults. Yet, when need and merit factors are set against one another, German but not Turkish children's allocation decisions are significantly influenced by their age. Younger children in both countries gave more resources to the needy and lazy character. Only older children in the German sample gave a similar number of resources to both characters, thus giving more relative weight to the non-needy character's merit. We did not find this age effect in the Turkish sample. Moreover, results suggest that children's and adults' decisions are contrasting with each other: Adults in both cultures distributed more resources to the non-needy and hard-working character. Hence, while being in need is more salient or evolutionary easily detected by children, being hard-working becomes an important factor for fair allocation with age when those factors are presented together. Our results indicate that concerns for need are relevant for young children's resource allocations across cultures. However, even when the need of the characters varies, merit concerns are relevant already at a young school-age for German children, but not for Turkish children. These results reflect the difference of the cultures' emphasis on the individual's over the collective's prosperity and shows that the development of children's fairness concerns follows cultural specific trajectories.

## PB-034 How do children's presence and gender affect their parents' reciprocal behavior?

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Adults' behavior is a salient social input for children's socialization (Bandura, Ross, & Ross, 1961). Adults who constantly interact with children, such as parents and teachers, model a variety of norms, and among those would be gender-specific patterns that may encourage gender-specific outcomes (Chaplin & Aldao, 2013; Rose & Rudolph, 2006). One research domain in which gender differences are found is prosociality (e.g., Benenson et al., 2019). The current study integrates the two domains by addressing parents' reciprocal behavior towards unfamiliar partners – The core question is to what extent parents' reciprocal behavior will be affected by the presence and gender of their child.
First, a one-factorial between participants design included 56 4.5-year-olds (Mage=4.64, SD=1.03; 44% girls) who underwent a reciprocal interaction with an unfamiliar, age and gender-matched peer. Peers were presented via pre-edited videos and decided to distribute resources in an egalitarian manner (i.e., three stickers for the peer and 3 for the participant) OR a selfishly one (i.e., 5 for the peer and 1 for the participant). Then, participants were allowed to choose one of two distributive options in response (i.e., '3-3' / '5-1'), and the procedure was over. Two fisher exact tests were made per gender to assess boys' and girls' responses to the peers' prior behavior. For boys, there were no differences in their responses towards egalitarian or selfish peers (p=.094), as most of them chose a selfish response regardless of the peer's prior behavior. However, a significant result was found for girls (p=.01) who have acted differently towards prior egalitarian or selfish peers (Fig 1.A.).
Second, a 2X3 between-participants design included 179 parent-participants (Mage=38, SD=5.6; 52% mothers) who underwent an adult version of the procedure above, namely, with an unfamiliar adult peer and money as the endowment (i.e., three 5$ bills for each OR five 5$ bills for the peer and one for the participant). Participants were randomly assigned to one of two Peer Behavior conditions (egalitarian/selfish) and one of three Child Presence conditions (i.e., played in the presence of their son, daughter, or no child presence). Two glm models were made per Peer Behavior, including parent age as a covariate and Child Presence as independent variables. Towards egalitarian peers, the model was insignificant compared to a null hypothesis since the vast majority of parents responded in kind, regardless of Child Presence (Fig 1.B.1). However, towards selfish peers, the model was significant ($\chi^2(81) = 109.8$, $p<.05$), revealing differences between parents' responses in the presence of their sons vs. daughters (estimate±SE=-1.33±0.56. z=-2.36, p=.018) (Fig 1.B.2). Three additional chi-square tests per Child Presence further demonstrate that only in the presence of their sons, parents' selfish responses were significantly different from chance ($\chi^2(1) = 6.12$, p=.013).
The findings exposed nuanced behaviors of parents (fathers and mothers alike), which depend on the gender of their child. While most parents were fair toward previously fair partners regardless of their child's presence or gender – towards a selfish partner, parents acted more selfishly (or perhaps, spitefully) primarily in the presence of their sons.

## PB-035 The role of knowledge in pragmatic inference: 18-month-old infants interpretation of pointing directed towards an occupied place

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Recent studies have demonstrated that shared knowledge about objects' typical placement serves as an inferential base for interpreting pointing. But sometimes, the typical and the actual state may differ with or without the speaker being aware of that. Using an eye-tracker paradigm, we investigate how the speaker's epistemic state helps 18-month-old infants coordinate these two types of information when interpreting pointing directed towards occupied places.

We show a video to infants of an adult who first teaches the typical placement of familiar toys, then witnesses their removal from their boxes. Later the objects switch places in the presence or absence of the adult. Then the adult points to one of the occupied boxes. In a subsequent scene, we present the two toys in novel locations. We compare children's looking time directed towards the objects to investigate which object children interpret the pointing as referential.

We predict that if the speaker is ignorant of the actual state, children will interpret the pointing towards the occupied location as referring to the object that is typically there. On the other hand, if the speaker has knowledge about the actual state, children will interpret the pointing as referring to the object that is currently there.

Data collection is still ongoing. Preliminary results will be presented during the conference.



## PB-036 The impact of social exclusion on children's gaze cuing of attention

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Being socially excluded is a negative experience that elicits aversive feelings and threatens important psychological needs, inducing considerable physiological, cognitive and behavioral changes in humans (e.g., Bass et al., 2014; Kawamoto et al., 2014; Bourgeois & Hess, 2008). Literature demonstrated that ostracism influences the processing of social stimuli in adults (e.g., DeWall et al., 2008; Bossi et al., 2018). For example, it was shown that adult participants, after being excluded at an online ball-tossing game (i.e., Cyberball, Williams et al., 2000), were less accurate in identifying the direction of human eye gaze (Bossi et al., 2018). However, little is known about how children react to self-experienced social exclusion and about the impact of social exclusion on children's processing of social signals. The aim of this study is to explore whether being included or excluded in a Cyberball game can influence the processing of eye gaze direction in 6-, 8- and 10-year-old children.

After being involved in the Cyberball paradigm, children are required to detect a target appearing on the right or left of a central face cue orienting its eyes either to the left or right. Children are also asked to complete the Primary Needs Questionnaire – Children (PNQ-C) to check the effectiveness of the Cyberball manipulation and their behavior during the Cyberball game will be offline coded. Data collection and analyses are currently ongoing. Preliminary data from the PNQ-C questionnaire indicate that at 8 and 10 years of age children perceive social exclusion during the Cyberball and report fundamental needs threat. Results from the attentional task show that included 6 years old children significantly benefit more than excluded children from the information conveyed by the social cue when orienting their attention. In addition, children's behaviors during the Cyberball game are currently being coded as we expect to acquire behavioral information to shed light on children's perception of being socially excluded vs included and investigate possible differences or concordances between PNQ-C answers and behavioral reactions. Obtained results will offer the possibility to elucidate the impact of social exclusion on the processing of social signals across childhood and will provide novel inputs for possible early interventions to prevent and/or mitigate ostracism's impact on school aged children.

## PB-037 The Effect of Interleaving on Minimal Pair Word Learning in 14-month-old infants

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INTRODUCTION: Although infants learn words before they are six months old (Bergelson & Swingley, 2012), they have difficulties learning words that are minimally different at 14 months (e.g., bih/dih; Stager & Werker, 1997). Prior work has shown that variable input, such as hearing several speakers, can boost minimal pair word learning at this age (Höhle et al., 2019, 2021; Quam et al., 2017; Rost & McMurray, 2009, 2010). One type of input variability, namely the order of presentation, has not yet been systematically investigated in infants. Studies with adults have shown that interleaving—or alternating—the presentation of category exemplars (abcabcabc) benefits visual category learning in comparison to blocking exemplars (aaabbbccc) (Brunmair et al., 2019). Based on this work, we hypothesize that interleaving highlights between-category differences also in the auditory domain and expect a facilitative effect for infants' minimal pair word learning, even without any within-category variability (multiple speakers). To address this question, we used a modified version of the habituation-switch paradigm and included test trials throughout the learning phase to measure the emergence of word-object associations.

METHODS: We will recruit twenty-four 14-month-old German-speaking infants. They must learn phonotactically legal minimal pairs in German that differ in the initial consonant (/bu:k/ vs. /pu:k/, one token each from a single speaker). Each "word" is paired with one of two unfamiliar objects (Horst & Hout, 2016). The testing procedure consists of two phases (Fig. 1). The familiarization phase includes

six blocks of 12 word presentations. During each block, the two word-object pairs are presented in alternating order (/bu:k/,/pu:k/,/bu:k/,/pu:k/, 24s in total). Following an attention getter, a 5s preferential looking test trial is presented, in which both objects are shown side by side with one of the words embedded in a carrier phrase "Schau mal…" ("Now look…"). Infants' looking behavior will be recorded by an eye tracker. During the test phase, three trials with one word-object pair (repeated seven times for 14s) are presented. The Same trial matches the pairing from the familiarization (e.g., /bu:k/ and green object), whereas in the Switch trial the same object is paired with the other word (e.g., /pu:k/). The final Novel trial contains a completely new object with /bu:k/ or /pu:k/.

PREDICTED RESULTS AND SIGNIFICANCE: For the classic test trials, we expect infants to look longer to the Switch compared to the Same trials. Given the difficulty of the task and the unknown effect size of interleaving, we anticipate that the preferential looking test trials will be more sensitive than the Switch and Same trials. Measuring the looking preference after each familiarization block is innovative because it enables us to track learning progress. We predict that the proportion of target looks in these trials will increase with each block, an indication of minimal pair learning. This study assesses whether interleaving—a form of variability—draws attention to relevant acoustic contrasts that distinguish minimal pairs, thereby supporting infants' minimal pair learning. Data collection is 30% complete and results from the full sample will be presented at the conference.

## PB-038 The development of irony comprehension

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Research on the development of irony comprehension does not show a consistent acquisition pattern. While several studies point to a relatively late development during late childhood or even adolescence (see, e.g., Demorest et al., 1984), others suggest that children may be sensitive to ironical uses much earlier (around the age of 6, see Köder & Falkum, 2021). Methodological differences may explain some of these inconsistencies. For instance, Köder and Falkum (2021) avoided measures requiring metalinguistic reasoning and tested irony comprehension ("Your room is very tidy" uttered in the context of a messy room) by asking children to choose which emoticon (a happy vs. an angry face) would best represent the speaker's inner feeling. However, it is an open question whether young children's responses to this kind of task reflect a full-fledged understanding of irony or merely a sensitivity to the fact that the speaker's positive expectation (a tidy room) has been disappointed in context.

Furthermore, the variability in developmental findings underlines the importance of determining which capacities constitute the cognitive repertoire that supports irony comprehension. Mazzarella & Pouscoulous (2021) propose that grasping the ironical attitude requires exercising advanced forms of epistemic vigilance ("second-order epistemic vigilance"), which would be needed to recognize that the ironical speaker is distancing herself from a source deemed unreliable and/or a content that is considered false or irrelevant.

The present study has a two-fold objective. First, to assess whether or not young children's successful performance in irony comprehension tasks is reducible to sensitivity to the presence of a mismatch between expectations and context. Second, to explore the role of epistemic vigilance in buttressing irony comprehension. We adapted the offline picture selection task of Köder and Falkum (2021) in two relevant ways. We introduced a control condition in which the presence of a mismatch between the speaker's expectation and the context is followed by a literal, positive statement (which should lead to a different behavioural answer than irony). Furthermore, we manipulated the reliability of the target of the irony. The study has a 2 X 4 design, with both Reliability (Reliable, Unreliable) and Utterance Type (Literal praise, Literal criticism, Irony, Control) as within-subjects factors.
We are currently collecting data from 6- to 8-year-olds (40 participants per age group/per condition. We expect to see a clear improvement in irony understanding with age and better performance in the unreliable condition than in the reliable condition. If these predictions were confirmed, we would be in a position to establish that young children do have a full-fledged understanding of irony and that this is supported by their epistemic vigilance capacities.

## PB-039 Missing /y/: Perception for vowels in two groups of bilinguals – with and without a rounded high front vowel

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Bilinguals can hold in mind two different perceptual representations for speech sounds that differ across their languages, as shown in a recent study of perception for /b/ and /p/ in English and Mandarin Chinese, where both languages have a phoneme contrast but the acoustics of typical pronunciations differ (Pan et al., 2022). It is not well understood how bilinguals will perform if one language has a phoneme contrast while the other does not. One target for investigation is the high front rounded vowel /y/, which occurs in Mandarin but not in English, Malay or Tamil. This leads to a mismatch in the vowel inventories of different bilinguals in Singapore. Across the dominant ethnic groups, 85% of people under the age of 50 report using more than one language at home (Singapore Census, 2020), with English accounting for the main language in most homes, typically alongside one of the other official languages: Mandarin, Malay and Tamil.
Here, we investigate vowel perception in English-Mandarin bilinguals (N = 51) and English-Malay bilinguals (N = 47) using a lexical identification task for Singapore Mandarin words 椅 (/i2/ 'chair') and 鱼 (/y2/ 'fish'). We created a 16-step vowel continuum, by synthesizing intermediate steps between two tokens of natural speech (edited for duration and pitch), using the Tandem-STRAIGHT approach (Kawahara et al., 2008). In the task, participants were asked to make binary decisions about which of two pictures matches the auditory stimulus in a given trial. Over 10 blocks, partici-

pants hear 160 speech tokens, in a random order. For each stimulus step, the proportion of trials in which the stimulus was heard as /y/ is computed. For each individual, a psychometric function is fitted to their responses, and a crossover point is computed to represent the shift from perceiving mostly /i/ to perceiving mostly /y/. According to a preregistered analysis plan (Pan & Styles, 2022), recruitment will continue until we reach an adequately powered sample size of 51 for each bilingual group (Current totals: English-Mandarin = 51; English-Malay = 47). We predict that the two bilingual groups will show different perceptual gradients across the /i/ to /y/ spectrum, due to the differences in their language experience. Our preliminary observations suggest the slopes of the two groups are indeed different (English-Mandarin bilinguals: Range = 0.51 - 3.79, Median = 1.45; English-Malay bilinguals: Range = 0.30 - 3.79, Median = 1.18). Hypothesis testing will follow when the target N is reached. If this pattern is significant, it will suggest that bilinguals with early exposure to both /i/ and /y/ in Mandarin develop a steeper perceptual gradient than bilinguals who hear almost exclusively /i/ over development.

## PB-040 Word learning strategies in 3-year-old mono- and bilingual children

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Prior research suggested that children's referent selection and word learning might be affected by their linguistic experience, in particular their bilingual language acquisition. One line of research, e.g., proposes bilingual advantages in disambiguation tasks, especially those that require children to understand the speaker's communicative intent (e.g., Yow & Markman, 2015). On the other hand, there is research suggesting bilingual difficulties in disambiguation, e.g., in identifying or retaining referents in the classic mutual exclusivity (ME) task (Markman & Wachtel, 1988) which requires children to select an unfamiliar (vs. familiar) object as the referent for a novel word (e.g., Byers-Heinlein & Werker, 2009; Rocha-Hidalgo et al., 2021). In this line, it has been proposed that bilingual children, in contrast to their monolingual peers, do not adopt ME as a word-learning strategy, possibly due to their experience of learning synonyms for already familiar concepts (Kalashnikova et al., 2018). The current study aimed to address such potential differences in mono- and bilingual children's word learning strategies: We tested whether we could confirm bilingual (dis)advantages in word disambiguation and learning proposed by prior literature. Thereby, we also assessed in how far potential bilingual difficulties in learning words after the classic ME task are specific to the ME inference or merely reflect general difficulties of bilingual children in word learning tasks (e.g., because of feeling less comfortable with the test language). In a pre-registered online study, we tested 3-year-old mono- and bilingual children's referent selection and retention performance in different contexts. Participants were presented with two disambiguation tasks: In the "Classic ME" task, a speaker asked for a novel label in presence of one known and one unknown object. In the "Pragmatic" disambiguation task, we did not present any known objects. Instead, children could infer from the pragmatic context that a speaker who excitedly used a novel word in the presence of two unknown objects, likely referred to the one which is new in their discourse. To date, data collection is ongoing and expected to be

completed until January. Our preliminary results (n = 27) suggest that both mono- and bilingual children were similarly able to infer the correct referents in both conditions to a similar extent. After 5 minutes, monolinguals successfully remembered their choices, though only above chance level in the classic ME condition, while bilinguals did not perform better than expected by chance in either condition. Such a pattern of results, if confirmed by the whole data set, would suggest, firstly, that the bilingual pragmatic advantage proposed by prior literature might either be more specific to areas of pragmatic skills other than those examined in the current study, or less robust than assumed (see also Antoniou et al., 2019). Secondly, bilingual children, in contrast to their monolingual peers, may indeed perform worse in learning words after disambiguation in the classic ME task. However, instead of reflecting different word learning strategies, these differences rather hint towards general difficulties for bilinguals in learning words in such experimental settings.

## PB-042 3D tracking of non-human primate in daily living space

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Comparative research with primates provides an evolutionary perspective on human behavior. Great ape social interaction and social bond are often studied through observing naturalistic behaviors, with proximity as one of the key features of social bond. Traditionally measured with visual estimation, inter-individual distance remains difficult to investigate on a finer level. We propose a computer vision-based method to quantify ape's daily movement in a zoo enclosure to look into the dynamics and nuances of dyadic movement. We are in the process of developing a deep learning pipeline to detect, track and identify individuals. We curated a dataset on a chimpanzee group at Leipzig Zoo, which contains 21 individuals with mixed sexes and ages, and experimented with various computer vision models to compare their performance in faced with limited amount of animal annotation. With preliminary tracking segments, we show that relative dyadic movement can be diverse and has the potential to create a profile for dyadic relations. We plan to characterize individual traits and social relations with daily movement, and make predictions on the tendency and performance of individuals and pairs in social cognitive tasks. We propose to use this method to establish a link between naturalistic behaviors and controlled behavioral tests that examine cognitive processes in great apes.



## PB-043 Preschoolers' sensitivity to the total-partial distinction of adjectives

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Gradable adjectives are commonly thought to be evaluated along a scalar structure (e.g., 'Ann is tall': the degree of height of Ann exceeds some measure; for more cf., Cresswell, 1976; Kamp, 1975; Bierwisch, 1989, etc.). Total and partial adjectives, that form a subclass within gradable adjectives,

are antonym pairs that map onto scales that semanticists ascribe a marked structure. The end of the scale onto which the total attribute is mapped functions as a "closed" point, and therefore a total adjective may only refer to a single value on the scale, while its antonym maps to the "open" end of the scale, thus may take up more than one values (cf., Rotstein and Winter, 2004). The evaluation of such antonym pairs invite different verification strategies. For instance, in the case of the scale of cleanness, the verification of the total member, clean, involves checking for a lack of dirt, while for dirty to be an accurate description any amount of dirt will do. In other words, while the applicability of a total adjective is blocked by the presence of the antonymous feature, this is not the case with partial adjectives. Understanding of this asymmetry seems necessary for the correct usage of such modifiers.

To examine the acquisition of these terms, we tested 4-year-old children. In a touchscreen experiment, children were familiarized with two devices that had a special function: they could transform an attribute into its opposite. For instance, a cleaning device turned an entirely dirty duck into a clean one, while a contaminating device made a clean duck dirty. In the test phase trials, participants were presented with two antagonist devices side-by-side, however this time they applied the same feature. The changed behavior of the transformers was reported to the participants as a malfunction. Children's task was to identify which transformer was broken. In the critical trials, the devices carried out their function only partially, both yielding an outcome that was half clean and half dirty. If children are sensitive to the verificational asymmetry of total and partial adjectives, then in this case one can expect them to flag the transformer device applying the total feature as broken. Our findings are compatible with this expectation, indicating that children by their fourth year are sensitive to the distinction between total and partial adjectives.



## PB-044 The slower they swim, the faster they fly! Can preverbal infants learn antitonic functions?

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Monotonicity Logic supports deductive inferences across a wide variety of content domains, including perceptual magnitudes and mathematics. Monotonicity has also emerged as a foundational building block for much of natural language semantics and language processing (Icard&Moss2014). Nevertheless, the developmental origins of the logic of monotonicity in the human mind are unknown. One hypothesis is that monotonicity emerges from reasoning with explicit quantifiers, negation and other natural language constructions. This conjecture has, however, not been directly tested. To address this gap, we investigate the foundation of Monotonicity Logic in preverbal infancy.

A primitive of Monotonicity Logic is the notion of an antitonic function: a function that flips the ranks in an order domain, like "minus" for numerical order ("-(2)" is more than "-(8)") and negation for logical relationships ("NOT(mammal)" entails "NOT(dog)"). Previous studies found that 8-month-olds struggle to

encode an antitonic mapping between two distinct magnitudes (e.g., more dots correspond to shorter lines (DeHevia&Spelke2010); longer sounds correspond to shorter lines (Srinivasan&Carey2010)). However, it is unclear whether those failures reflect a true lack of competence.

To more directly assess preverbal infants' logical primitives, we probed whether infants can learn arbitrary antitonic functions within the same domain: they had to learn that the left-to-right order in which a school of flying-fish swims fully flips when they fly (e.g., swimming (fish1-fish2-fish3-fish4-fish5)) → flying (fish5-fish4-fish3-fish2-fish1)). In an online procedure, two groups of 14-month-olds were habituated to movies where schools of five flying-fish alternated between swimming in the water and flying in the air. For half of the participants (N=15), the fish followed an antitonic pattern, in which the left-to-right order flipped between swimming. For the other half of the participants (N=16), the fish followed a monotonic pattern, in which left-to-right order was preserved between swimming and flying. At test, infants were presented with movies of two new schools of fish: one followed the antitonic pattern, the other the monotonic one – alternating across six trials. An ANOVA detected a main effect of whether the test pattern was the same as the habituation ($F(1,29)=7.9$; $p=0.008$) and no interaction with the type of habituation ($F(1,29)=1.2$;$p=0.28$): infants who were habituated to the antitonic manipulation looked longer at the monotonic fish in test (Mmono=12.5s, Manti=5.3s); those who were habituated to monotonic manipulation did the opposite (Mmono=9.8s, Manti=13s). This result is consistent with the encoding of an antitonic function. Alternatively, infants might have encoded rules about specific items in the series (e.g., swimming (fish1 is first)) → flying (fish1 is last)) or representations of same/different order. To rule out these alternatives, in an ongoing experiment (TargetN=32) we ask whether infants readily learn non-monotonic transformations (e.g., swimming(fish1-fish2-fish3-fish4-fish5) → flying(fish4-fish1-fish3-fish5-fish2)). A failure to learn in this non-monotonic condition would suggest that the representation of monotonicity may be a developmental primitive of the mind and support the detection and encoding of logical relations between ordinal variables. This primitive representation may be a foundation of the human capacity for deductive inferences across a wide variety of content domains.



## PB-045 Investigating behavioural patterns of 18-month-old infants during mirror self-recognition

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The Mirror Self Recognition (MSR) test is a widely used measure of visual self-recognition that typically categorizes participants into two groups: recognisers and non-recognisers. While MSR is a direct measure of physical self-recognition, there is considerable evidence that it also indexes so-called "objective self-awareness". One drawback of the MSR test is the binary outcome and the rigid criteria that is used to determine "recognition" (i.e., touching of the mark). This often does not capture the nuance in infants' behaviour and can lead to ambiguous cases when infants do not touch the mark but show behaviours that may indicate visual recognition (e.g., looking at or scrunching one's nose

in the mirror). The present study used a Machine Learning Model to better understand whether other behavioural patterns could predict infants' mirror recognition status. Using data from 139 18-month-old infants (M = 563.5 ± 15.99 days) across 3 studies, our model reached a high classification accuracy. In particular, the model found that mirror recognisers had a shorter phase duration (Mphase1 = 34.82 ± 21.9s, Mphase2 = 49.25 ± 37.4s) than non-recognisers (Mphase1 = 55.65 ± 43.8s, Mphase2 = 95.4 ± 54.6s) both before and after the mark was placed (t(137) = -3.49, p = .0008, t(137) = -5.88, p = <.0001, respectively). A phase was defined as the time taken for a child to look in the mirror 3 separate times or for 10 consecutive seconds. This suggests that mirror recognisers tended to look towards the mirror or fixated on the mirror for more than 10 seconds consecutively more quickly than their non-recognising peers. A secondary finding was that mirror recognisers tended to look in the mirror for a longer time in the first 30 seconds of the phase than non-recognisers after the mark was applied (Mrecognisers = 8.49 ± 3.27s, Mnon-recognisers = 6.05 ± 3.47s, t(137) = 4.38, p = <.0001). Finally, we also found that mirror recognisers tended to look in the mirror for about the same length of time in the first 30 seconds in both phases (t(66) = -1.26, p = .10), but non-recognisers did not (t(71) = 3.79, p = .0003). Specifically, non-recognisers tended to look significantly less in the mirror in the first 30 seconds after having the mark applied, than in the baseline phase prior to mark application compared to mirror recognisers. These findings suggest that a combination of different behavioural patterns can be used to correctly identify mirror recognisers, particularly in cases where there may be ambiguous behaviours that suggest self-recognition. Furthermore, these additional parameters may be tools for a new framework in which the outcome of the MSR test is more nuanced than binary.

## PB-046 Curiosity in Free Play: How Children Explore in Absence of External Rewards

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Children are arguably the only known systems that demonstrably and reproducibly develop into intelligent agents through playful exploration. Children's free play can be considered the purest form of curiosity, as it conveys the desire to explore in the absence of clearly-defined, externally-imposed rewards. In this work, we hypothesize that children's exploration during free play serves as a cognitive gym, aimed to practice and prepare for challenges that may come. In this sense, during free play children may train by self-imposing goals and practicing how to optimize different goal-oriented strategies and policies. This training can be extremely powerful, as it not only maximizes children's understanding of the environment under exploration but also generates knowledge that supports generalization to novel and unforeseen scenarios.

In our paradigm, 5- to 9-year-old children are introduced to a tablet game where they can create 2D blocks of different colors, shapes and sizes, and then place and manipulate them on a virtual

play-field that simulates gravity. Participants are randomly assigned to one of three play conditions (five minutes): In the Free Play condition, children are instructed to try whatever they want with the blocks; in the Abstract goal condition, they are given a very general goal (``build things''); in the Specific goal condition, they are given a specific goal (``build towers''). Children are then tested, using the same platform, and asked to build a tower as high as possible, build a bridge as fast as possible, and create as many different blocks as possible. Afterward, participants are presented with a test battery that examines their cognitive flexibility, as well as their competence in evaluating the stability of given structures.

Data collection is currently undergoing and is expected to be completed by the end of November. The available data (N = 16) suggests that children in the Free Play condition had a lower touch rate and spent more time creating new blocks rather than manipulating them, compared to children in the other conditions. Interestingly, preliminary data also indicates that children in the Free Play condition performed better at all test tasks. These preliminary results support the hypothesis that free, curiosity-driven exploration may indeed better prepare for the unknown coming challenges. Ultimately, this study will be able to enrich our understanding of how children spontaneously explore their environments, and how algorithms of child-like exploration could be applied to challenging problems in machine learning.

## PB-047 18-month-olds' sensitivity to adults' (in)congruencies in their emotional reactions towards action effects - a violation-of-expectation eye-tracking study

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At 14 months, infants can associate a person's displayed positive affect to an object at which the affect is directed, and expect that subsequent reaching-actions correspond to the primarily displayed preference (Phillips et al., 2002). Furthermore, they expect a person's actions to be congruent to the valence of their emotional expressions (Hepach & Westermann, 2013). At 24 months, infants can anticipate another person's reaching action by using their emotional expressions (Vaish et al., 2018). Emotional expressions and their implications therefore seem to be a crucial marker for infants when it comes to interpreting and predicting other persons' actions and preferences (e.g., Repacholi & Gopnik, 1997). However, research on infants' understanding of desires and preferences has mostly been assessed for others' attitudes towards objects or categories (e.g., Kampis et al., 2013; Yott & Poulin-Dubois, 2016). To account for the fact that in real life, action-goals often go beyond selecting or grasping a particular object, we aim to examine whether 18-month-olds understand that others' emotional expressions can also be directed at transient action-effects, which only appear after a particular action has been performed. In an eye-tracking study, we presented 18-month-old infants with videos depicting three adults. The person sitting in the middle, the "actor", performed two simple actions on a toy, one action eliciting a sound and the other a light effect. The two other adults observed

the actions and effects, and each observer reacted excitedly to either the sound or the light effect. Across eight familiarization videos with four different toys, all adults kept their roles and their sound or light preference. In the following test-phase, we presented four videos with a novel toy, during which the observers reacted either congruently or incongruently to their previously displayed effect preference. We used a within-subjects design and presented preference-congruent and -incongruent test-videos in alternating order. Data collection is still ongoing. We expect systematic differences in infants' gaze duration, eye movements, and pupil dilations in congruent vs. incongruent test trials. These would indicate that 18-month-olds extract the action-effects as target of the emotional expression and expect others' attitudes towards those action-effects to be consistent. This would be the basis for an understanding that others' actions can be driven by a goal that is not visually observable but rather consists of a particular effect that one's actions will produce on the environment.

## PB-048 Missing pieces in the puzzle of vocabulary development in multilingual Singapore

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Background: Children who grow up learning two languages do not typically differ in their total vocabulary size compared to their monolingual peers (Poulin-Dubois et al, 2012) though composition may be smaller compared to size with two word-forms representing one lexical concept. However, these studies often sample children from minority bilingual communities (Bialystok et al, 2010) where the languages may be used in somewhat separate contexts. By contrast, in Singapore more than 90% of young people are bi-/multilingual, and dense inter-generational community-level multilingualism is the norm. The education system has an active policy of bilingualism, and most children grow up in households where they hear two or more languages/dialects. In recent years, English has become the most frequently reported main language at home for children between ages 5-10 (2020 Singapore Census) indicating rapid language change. This language environment provides a unique opportunity to investigate individual differences in vocabulary development in a non-WEIRD massively multilingual community.

Tool Development: From our previous examination of vocabulary size on 140 Singaporean 24-month-olds, we found that, pooled across languages, vocabulary sizes ranged from 8-760 (25th, 50th, 75th percentile: 67, 179, and 271 word-forms respectively). These values are notably lower than reported vocabulary sizes for age-matched samples in OECD countries like the UK and North America (Fig 1). This mismatch is surprising given Singapore's rankings in standardized educational assessments such as the PISA (OECD, 2018), and suggests that the current assessment tools may be missing an important part of children's linguistic repertoire. In response to this, our multilingual team documented an entire tier of child-directed words that is not captured in vocabulary inventories adapted from monolingual materials. Many of these local words aren't easy to identify as belonging to one language or another (e.g., 'pom pom' for 'children's bathing') and likely arose from Singapore's dense

contact language environment. We refer to this tier of child-directed words as Red-Dot words. We then designed five new developmental vocabulary checklists for each of main languages spoken in Singapore (English, Mandarin, Malay, and Tamil) and Red-Dot.
Methods: Parents of 205 Singaporean children (age: 8m-36m) completed our new vocabulary checklists as a measure in our remote study, Talk Together Study. Parents were also asked to report estimates of care time and language-use ratios of each caregiver using our Language Experience Overview tool (Woon et al, 2021). We computed a caregiver-by-language matrix from these estimates to derive a Composite Language Input Profile (CLIP) for each child: a proportional representation of the language mix of their input from all caregivers.
Planned Analysis and interim results: We plan to explore the relationship between language input from caregivers (calculated as CLIP) and the vocabulary sizes of the children. Data collection is complete, but processing and analysis are still ongoing. Vocabulary sizes of the children, English: 0-629 (M=143), Mandarin: 0-535 (M=6), Red-Dot: 0-129 (M=9). CLIPs of 205 children growing up in multilingual Singapore are presented in Figure 2. The language mixes are diverse. All children receive English input (range: 2.85% - 100%, mean = 65.5%).

## PB-049 Children's and Adult's Prediction of Emotions in Cooperative Versus Competitive Resource Sharing Contexts

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From early in ontogeny, children have descriptive expectations that resources will be allocated equally (Geraci & Surian, 2011; Schmidt & Sommerville, 2011) and expectations about others' resource sharing become normative by around 3 years of age (e.g., Rakoczy et al., 2016; Smith et al., 2013). Here, an important question is whether children have any expectations about the beneficiary's emotional state (who stands to benefit from someone's resource sharing). Theoretically, a stark contrast in which a potential recipient may expect sharing or no sharing is between a cooperative and a competitive context. Already 14-month-olds show a basic understanding of cooperation and are able to form expectations about the consequences of cooperative actions (Wang & Henderson, 2018). Thus, in a resource allocation context, a potential recipient may be happy (expecting to benefit from sharing) if another individual reaches the shared goal in a cooperative context. In a competitive context, however, the potential recipient may be sad (expecting not to receive any resources) if another individual reaches their individual goal. Preschoolers readily attribute emotions to others in various contexts (e.g., Paulus & Moore, 2015; Pons et al., 2004). However, only little is known about children's anticipation of others' emotions in resource sharing contexts, such as in cooperative interactions. Thus, we investigated 3- and 5-year-old children's (N=80) predictions of a potential recipient's emotional state (happy vs. sad) in two resource sharing contexts. We developed an interactive online study with a target task that included two open-ended picture stories. Here, different individuals play a game to

obtain divisible resources in a cooperative or a competitive context. In the cooperative context, the individuals agreed on playing together, whereas in the competitive context, they agreed on playing individually against each other. In both contexts, children observe the "unlucky" individual (but potential recipient) not obtaining the resources themselves but witnessing the other "lucky" individual acquiring them. At the end of each story, children were asked whether the potential recipient would be happy or sad (forced-choice format). We found that older, but not younger preschoolers were more likely to expect the potential recipient to be happy in the cooperative versus the competitive condition. Results of a control task in which the lucky individual announces not to share anything (cooperative control) or to share with the other individual (competitive control) ruled out that children predicted the recipient's affective state based on inherent features of the tasks rather than based on the partner's or opponent's likely sharing behavior. To extend the insights into the developmental processes of emotion prediction and reasoning about resources, we conducted a follow-up study with two adult samples based on the original child study design (Study A, N=57, online and interactive; Study B, N=94, online and fully automated). The results revealed the same and even more pronounced response patterns that were found in older preschoolers. Thus, our work may open new avenues for investigating the ontogeny of normativity and may help bridge the literatures on norms, cooperation, and emotions.

## PB-050 Children increase their evidentiary standards in more unreliable informational environments

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Children are increasingly learning from online media sources, not all of which are reliable and few of which contain clear indicators of reliability. We present empirical evidence that children track the reliability of incoming information and become more diligent about fact-checking in less reliable informational environments. We asked 4-6 year-old children (N=60) to listen to a set of statements about jungle animals that were either entirely accurate (reliable condition) or contained some misinformation (unreliable condition), and judge their accuracy. Following this exposure phase, we asked them to judge the veracity of a novel claim about an alien species in a context with the opportunity to sample information to check the claim. Participants could choose to sample anywhere from 1 to 20 aliens, each of which provided positive evidence in support of the claim. Participants in the unreliable condition sampled significantly more aliens before accepting the claim than those in the reliable condition. This result shows that children sensibly adjusted the amount of evidence they required for validating a novel claim according to the reliability of the given informational environment. Greater engagement with the material in the unreliable context further supports existing developmental theories of uncertainty-driven learning. Work in progress investigates (1) whether children's level of skepticism shows a graded sensitivity to prior information quality, and (2) whether higher skepticism manifests not only in higher amounts of information sampled, but also in higher discernment between strong and weak evidence.

## PB-051 Towards the Micro Infinity: Children's Understanding of Infinitesimals

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Previous research showed that the development of children's understanding on micro-infinity (infinity associated with unlimited division) starts at the age of 11 with mapping a physical quantity onto the number which is understood as infinitely divisible (i.e., Smith, Solomon & Carey, 2005). However, in the studies conducted with younger children, micro infinity was investigated through the concrete object division tasks, which might lead children to use their prior knowledge about physical rules (i.e., infinite division of concrete objects can not be observed unlike the theoretical division of numbers).Thus, these rules may precede the abstract understanding of micro-infinity. However, little is known about how younger children understand infinity concepts and infinitesimals (a quantity that is closer to zero than any standard real number, but that is not zero) without the bias of physical rules. In this preregistered study, we asked 1) When does children's understanding of micro-infinity develop, 2) Whether understanding of micro-infinity is affected by knowledge of concrete object divisibility and 3) If the manipulation of physical rules in accordance with the nature of micro-infinity helps children to profess micro-infinity and infinitesimals in early ages.

Children (N = 80) aged 7, 8, 10, and 11 are displayed to an animation in which a target keeps eating a cake while biting half of it continually. For half of the children (Fantastic Group Condition), the scenario takes place in a fantastic world where different physical rules can be applied (i.e., a cake which can change the eater's size). In that animation, the target keeps eating half of the cake and shrinks by half the size. For the other half of the children (Control Group), the story takes place in a typical world where the target always bite half of the cake in hand without shrinking. In the Fantastic Group, shrinking of the target makes it possible to observe the continuous division of the object and it is more suitable for the nature of micro infinity and the concept of infinitesimals.

After the animations are displayed, children are asked, 'If the target kept biting half of the cake, would the cake ever disappear completely or always a half piece of cake remain?'. Children's answers are coded as -1 or +1 (for negative and positive answers). Also, children who give negative answers are asked 'Then, how many times do you think the target could bite the cake?' Children's answers are coded on an interval scale.

We hypothesize that listening to different scenarios (i.e., Fantastic Group vs. Control Group) about the object divisibility will affect children's understanding of micro-infinity and the concept of infinitesimals. We expect that children in the Fantastic Group Condition understand micro infinity and the concept of infinitesimals at an earlier age than children in the Control Group.

The findings of our study might help us gain a deep insight into the children's understanding of different infinity dimensions and their relation to the physical rules of the world.

## PB-052 Exploring the developmental system underlying early prosocial behavior

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Infants start to help soon after their first birthday and begin to help reliably during their second year of life, for example by handing over an object that is out of reach to another person. Early helping is one of the first developing and best documented prosocial behaviors and the last 15 years of research have shown that several developmental processes are involved in its ontogeny.
In a previous study it was demonstrated that infants' fine and gross motor skills, as well as social interaction skills predicted helping behavior at the age of 16 months. Furthermore, infants' understanding of others' needs, as measured in an eyetracking paradigm, predicted helping behavior when considering fine motor skills and social interaction skills as moderators. Besides these critical developmental skills, infants' socialization experiences showed to affect their development of prosocial behavior. Parental socialization goals, and parental practices, such as maternal sensitivity and scaffolding showed to be related to early prosocial behavior. Cross-cultural research further pointed to differences in these environmental aspects and their influences on prosocial behavior across distinct cultural contexts.
With our work, we would like to replicate and extend prior studies with a large sample (expected N=50) from an urban German cultural context (Berlin). We examine infants' critical developmental skills and their social environment and further investigate early precursors of helping behavior to better understand the developmental system underlying prosocial behavior. We currently conduct behavioral experiments with infants at 12 and 16 months of age as part of a longitudinal study project at Charité-Universitätsmedizin Berlin. At 16 months of age, we assess infants' helping behavior in three instrumental out-of-reach tasks, and infants' social interaction skills. Prosocial understanding is assessed by using an eyetracking paradigm in which we test whether infants understand another character's need for help. Gross and fine motor skills are assessed at the age of 12 and 16 months. In order to analyze infants' social environment (namely maternal scaffolding), we ask mothers to assign simple tasks to their infants with 12 and 16 months. We will present our findings with regard to these hypotheses: 1. Infants' motor abilities (12 and 16 months) and social interaction skills (16 months) are associated with early helping behavior. 2. Infants' motor abilities (12 and 16 months) and social interaction skills (16 months) moderate the link between prosocial understanding and early helping behavior at 16 months. 3. We expect more deliberate than sensitive or assertive maternal scaffolding in our sample in urban Germany (12 and 16 months). 4. Maternal scaffolding (deliberate, sensitive, assertive) at 12 and 16 months will be associated with early helping behavior at 16 months of age.

We further provide an outlook on the longitudinal project our study is part of, in which we will also investigate infants' brain development, as well as genetic and environmental factors that may contribute to the ontogeny of prosocial behavior.

## PB-053 Neurophysiological evidence for continued object processing on behalf of others in infancy

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Infants' ability to track what other people can or cannot see develops quickly within the second year of life, referred to as visual perspective taking. Recently, it has been proposed that infants own representation of the world may be biased by the perspective of others. That is, they may represent objects more strongly, and remember them better, when the objects are cued by the visual attention of another agent. To test if and how the visual perspective of another agent affects infants' neural object representation, we flickered objects in a 4 Hz rhythm, which evokes neural oscillations at the same frequency (referred to as steady-state visual evoked potentials, SSVEP) that can serve as a specific neural signature of infants' object representation. In our study, infants were presented with an agent observing a flickering object that either disappeared into a tunnel (blocking both the infant's and the agent's view) or behind an occluder (blocking only the infant's but not the agent's view). We hypothesized that infants (aged 12-15 months) will not only show an SSVEP response if they themselves see the flickering object, but also show entrained oscillations in response to someone else seeing the object, even after this object was no longer visible to themselves. Indeed, infants (N=56, final sample according to Bayesian sequential testing scheme) showed evidence for a higher 4 Hz response after object occlusion when the agent continued to see the object (occluder condition) compared to when she could no longer see it (tunnel condition). These findings indicate that infants continue to process objects on behalf of another agent even when the infants no longer see the object themselves, indicating an altercentric enhancement of infants' object memory.



## PB-054 Infants' reactions to a robot during the still face procedure

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Parents of recently born infants are often busy with activities other than attending to, and interacting with, their babies. Can robots serve as a surrogate to interact and soothe infants when their parents are temporarily unavailable? We explored this question using the classic Still Face paradigm. Infants

aged five to nine months and their mothers participated in our study. The mothers first interacted with their infants for 2 minutes normally, and then displayed still face for 2 minutes, a robot started to interact with infants for 2 minutes. Then, the mothers interacted again with the infants for 2 minutes. During these interactions, we measured infants' heart rate variabilities using transdermal optical imaging, a contactless video-based technology. The same participants also experienced a control condition where the robots did not interact with the infants and compared infants' behavioral and physiological reactions between phases and conditions. Preliminary results showed that infants' behavioral and physiological responses were similar to both robots and mothers, except that their stress was slightly but not significantly elevated when their mothers posed still face but the robot interacted with them. The findings of the present study suggest that robots in their current state might potentially not be appropriate to serve as a surrogate of the mother temporarily and provides novel evidence about how to improve robot design to improve their appeal to infants.

## PB-055 Investigating unexplained phenomena: Are children more likely to explore surprising claims when they are presented without supporting explanations?

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Prior research on children's selective exploration indicates an early emerging sensitivity to knowledge uncertainty, which in turn guides children's exploration and improves their learning about novel objects and their properties. Such exploration, whether it takes the form of questions or of first-hand exploration, is often aimed at obtaining explanations for these surprising phenomena. When presented with a surprising claim, older engage in more exploration than younger children; they also engage in more targeted exploration than younger children. These age-related differences in exploration may reflect age-related increases in the ability to reason about why a surprising claim may or may not be true. Indeed, children's explanations shape whether and how they explore. This pilot study tests the hypothesis that older children's decisions to test a surprising claim will vary depending on whether they are provided with a claim that does vs. does not include an explanation.

Using a within-subjects design, we presented 6-7-year-old children (anticipated N=20) with a series of vignettes in which they first hear a surprising comparative claim about one of three objects, before being asked whether they would like to suggest exploratory behaviors. To manipulate the degree to which the claim required further testing, half of the claims were supported by an explanation about how the informant acquired their knowledge, whereas the other half were left unsupported (i.e., accompanied only by irrelevant information).

For our main analysis, we predict a main effect of Level of support (Supported versus Unsupported). When a surprising claim is presented with a supporting explanation, we expect that children will be unlikely to suggest exploratory behaviors. In contrast, we expect that when a surprising claim is left unsupported children will be more likely to suggest that the claim should be verified through targeted exploration. Thus, we expect that the results of this study will support the notion that understanding the link between evidence and claims is a key driver of children's inclination to suggest that a surprising claim should be tested.

## PB-057 The development of identity fusion

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Identity fusion is an intense form of social cohesion, usually elicited by shared transformative experiences, either euphoric or most likely dysphoric, that makes individuals willing to pay a cost for the benefit of their group (Kavanagh et al., 2020). It has been postulated that, when identity fusion occurs, boundaries between personal and social identities become blurred to the point that individuals perceive the self to be at one with the group (Swann et al., 2009). At present, there is a vast literature showing that identity fusion is responsible for altruistic intentions in adults, although studies employing behavioural paradigms are scant. In contrast, there is still no evidence speaking to the role of identity fusion in motivating children to endorse or engage in costly pro-group behaviours (Reese & Whitehouse, 2021). Moreover, the cognitive underpinnings of identity fusion are virtually unexplored in both adults and children (but see Enock et al., 2018). Thus, we aim at investigating the development of identity fusion by paying particular attention to its behavioural effects and cognitive underpinnings. In order to address this gap in knowledge, we will conduct two studies. In Study 1, we will adapt identity fusion measures employed in adults for use in children, and then assess their validity. The verbal measure of identity fusion captures feelings of connectedness and reciprocal strength with the group, while in the pictorial measure participants have to choose the picture that best represents their relationship with the group among several options. For the validation to be successful, we will have to obtain the following pattern of results. The different identity fusion measures will need to show strong correlation with each other (convergent validity); show weak to no correlation with other scales, such as essentialism and group identification (discriminant validity); give consistent results across time (temporal stability); predict children's altruistic intentions and behaviours towards the ingroup (predictive validity).

Once identity fusion measures are validated for use in children, in Study 2 we will assess whether the relationship between identity fusion and altruism towards the ingroup is mediated by the cognitive overlap between self and ingroup representations. Additionally, we will assess whether this

relationship is moderated by participants' age, by comparing children with adolescents. Altruism will be evaluated in terms of both intentions and actual behaviours (as in Study 1). The cognitive overlap between self and ingroup representations will be evaluated through the perceptual matching task – a task measuring reaction times in recognising stimuli associated with the self, ingroup and outgroup. In addition to predicting altruism, we expect identity fusion to predict also performance in the perceptual matching task. More specifically, the higher the identity fusion level, the poorer the performance in discriminating self from ingroup stimuli, as opposed to self from outgroup stimuli. Crucially, we expect performance in the perceptual matching task to explain the association between identity fusion and altruism. Finally, we expect that the explanatory power of the performance in the perceptual matching task will be higher in adolescents than in children.

## PB-058 The fine structure of gaze and pupil dynamics reveals predictive internal models of interactive agents in 14-month-old infants

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Humans develop rich internal models of their environment, including its physical properties and the agents inhabiting it. While internal models of either the physical or the social environment have long been studied, how they are integrated into a unified predictive mechanism remains unknown. Here we studied the detailed eye movement and pupil dilation patterns of 14-month infants while they were looking at dynamic scenes involving two agents moving in a circular arena.

The agents' movement trajectories obeyed basic physical principles and included dyadic chaser-chasee interactions. We constructed a set of increasingly sophisticated models predicting moment-by-moment the agents' future positions based on their past trajectories. The simplest model only "predicted" the last seen position of agents, while the other models made predictions either based on only the simple physical rules governing the movements of the agents (linear motion with reflection at the boundaries of the arena), or also taking into account their dyadic interaction (chaser follows chasee). The physical rules of movements were modeled with or without considering the stochastic element of the actual trajectories, while dyadic interactions were modeled using the true assignment of chaser vs. chasee roles to the two agents, or the reverse assignment.

We then modeled infants' eye movements as following these moment-by-moment predictions, and fitted the parameters of these models (e.g., sensory lag, prediction horizon, centre bias, and eye movement noise) to gaze position time series data collected during infants' free viewing of the displays. We found that infants' eye movements were best explained by predictive models of the agents' movements that adopted both the physical rules (including stochasticity) and the dyadic interactions

(with correct role assignments) underlying agent trajectories. Critically, after fitting these models to gaze positions only, a measure of Bayesian surprise extracted from the best predictive model (but not the other models, nor heuristic measures of surprise) also predicted dynamic pupil dilation data during eye movements. The trial-by-trial evidence for infants employing a dyadic internal model, based on their eye movements during free viewing, also predicted their performance on a concept-learning task involving the agents' dyadic roles following free viewing.
These results suggest a deep integration of the knowledge of physical and dyadic interactions into a unified internal model which infants deploy at a sub-second time resolution to make predictions about their environments. More broadly, our study also provides proof of principle for using detailed analyses of eye movements to reveal rich internal models in infant cognition.

## PB-059 Selective teaching in development: preferential information transmission following direct instruction and independent exploration in 2- and 5-year-olds

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Children effectively acquire information about their immediate environment in two main ways: learning through self-exploration and learning from others. They further reason about and treat information differently depending on whether they learned it independently or through others' deliberate instruction. The current study asked whether children distinguish between these two types of information when they themselves actively teach a naïve adult, aiming light on the developmental trajectory of selective information transmission. 2-year-old toddlers and 5-year-old children (planned N=80, current n=70) were presented with two simple novel boxes that were perceptually identical except for the orientation of a different-coloured button on each box. Pressing a button played different but similar tunes or turned on different coloured light bulbs. In the learning phase, children were given an opportunity to learn about box's functions both through independent exploration and through direct instruction: an experimenter showed how to operate one of the novel boxes in one trial and they were given an opportunity to independently explore the other box in another trial (different boxes presented in two blocks, with order of presentation and trials counterbalanced). After children learned the functions of both boxes, at the teaching phase, a second experimenter, a naïve adult, asked to demonstrate how the boxes worked. Children's first demonstrated functions and overall frequency of both types of functions taught were coded from video recordings. Preliminary findings indicate that toddlers and older children behave differently when teaching newly acquired information through the two means. 2-year-old toddlers preferentially teach what they have been directly instructed, whereas 5-year-old children do not show such selectivity, instead simultaneously demonstrating both functions to the naïve adult. This suggests that toddlers might have an early-emerging sensitivity to preferentially share deliberately taught information in social learning contexts, especially when it is directly pitted against information acquired independently. However,

this tendency disappears in older children. This might be due to a combined influence of exposure to formal educational contexts and overall developmental maturity which shifts their focus from the social aspect of the information to the efficiency aspect of the information: older children may reason that a less knowledgeable adult would equally benefit from being taught all pertinent information, both previously directly taught by another informant, and learned independently through exploration.

## PB-060 Footprints of visual cortex organization in early object categorization

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We hypothesized that the first categories that infants represent are constrained by the dimensions that organize object representation in the primates' ventral visual cortex, giving rise to the categorical distinctions: animate/inanimate, human/nonhuman, faces/bodies, natural/artificial and big/small objects.

In a series of studies involving 169 infants in total, we analyzed differences in looking times between objects of the above categories. Results showed that 4- and 6-month-olds' behavior is primarily guided by low-level visual features such as image size; 8-month-olds are still sensitive to low-level differences between images but also show spontaneous categorization of objects along the animate/inanimate dimension. Ten-month-olds categorize objects as animate/inanimate, above and beyond low-level differences between images. More categories emerge between 10 and 19 months.

Moreover, as infants grow and represent more categories, their looking behavior correlates with the object-related neural responses in ever-larger portions of the visual ventral stream of adults, measured with fMRI, as if the formation of new categories is promoted by the progressive recruitment and integration of more and more feature spaces distributed over the visual cortex.

In another set of studies, we used EEG frequency-tagging to capture an automatic visuoperceptual correlate of the animate/inanimate categorization in a very heterogeneous set of objects. This response was already evidenced in 4-month-olds. Parallel work in adults shows that low-level visual features preserved in phase-scrambled images, and mid-level visual features preserved in so-called texform images, are sufficient to evoke the above categorical response, speaking in favor of a visual origin of the early animate/inanimate categorization process."

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# POSTER SESSION C: SATURDAY

## PC-001 What's first to a child's mind?

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When you are asked to think of a car, or how to deal with a burnt-out lightbulb, several possibilities might spring to mind, but most people report that there is usually a "first thing that comes to mind", faster and more easily than any other possibility. Recent work with adults has found evidence that sampled responses are a combination of what is descriptively likely and also what is prescriptively good; though adults have no difficulty reporting the descriptive average and prescriptive ideal separately (Bear & Knobe, 2017; Phillips, Morris, & Cushman, 2019; Bear et al., 2020). Although young children's responses reflect samples from a probability distribution when no prescriptive information is provided (Bonawitz et al, 2012), they may not distinguish between what is descriptively common and what is prescriptively good (Shtulman & Phillips, 2018), raising questions of what processes are involved in children's first-to-mind judgments. We set out to explore whether children's "mental defaults" resemble those of adults, and at what age children distinguish "average" and "ideal".

We designed a study in which participants (4-9yrs, adults) saw 100 examples each of two novel objects (in separate blocks) that varied along one dimension (width or height) with relative values ranging from 1-100, normally distributed around a mean of 40. Separately, participants were informed that the variable dimension was also related to prescriptive value, e.g., in one case that objects that were wider were better for their intended use. Participants were then asked to use a circular slider to generate an object following one of two prompts (between subjects). First-to-mind:"Think of an [object]. What's the first [object] you thought of?"; Descriptive Average: "A machine gives someone one of the [objects] at random. What does the [object] look like?". Participants then answered check questions confirming they understood the prescriptive value manipulation, and were asked to use the same slider to create the prescriptive ideal of the object type. This was repeated with a new object, and with an inverted ideal (i.e., if the ideal was "wider" for the first object, it was "shorter" for the second). This led to a 2 (Question; between) x 2 (Ideal; within) x Age mixed design.

Our preregistered sample of adults is complete; ~50% of the target (N=23) is collected per between-subject cell for children. However, preliminary results already show some clear patterns (Fig. 1): Children's and adults' mental defaults both show a combination of the descriptive average and prescriptive ideal, but while adults are fairly accurate when asked to produce the descriptive average, children's responses to the "average" question are nearly identical to their first-to-mind judgments. A mixed-model ANOVA finds a significant three-way interaction between Question, Ideal, and age in years, $p<.001$, and a two-way interaction between Ideal and age in the "average" Question condition ($p=.002$) but not the "first-to-mind" condition ($p=.06$). This suggests that children may have similar first-to-mind defaults to adults, and it is the ability to separate the descriptive average from the prescriptive ideal that emerges later in development.

## PC-002 Unpacking the literal bias in children's metaphor comprehension development

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If you were to stub your toe and say 'Ah - my toe is on fire!', there are two possible interpretations to take—that your toe is literally on fire or that your toe is in a lot of pain. Children largely choose literal interpretations which is referred to as the 'literal bias' in metaphor comprehension development (Vosniadou, 1987). We investigate why, between these two alternatives, children privilege the literal interpretations of novel metaphorical statements.

As an experimental analogue of the choice scenario above, metaphor comprehension tasks often require children to disambiguate between literal and figurative interpretations (e.g., Long et al., 2021). For example—after hearing "Lucy is a parrot"—3- to 6-year-olds were asked to choose which of three images the experimenter wanted: the parrot, the girl resembling a parrot, or a different girl (Long et al., 2021). Children often select literal (e.g., the parrot) over metaphorical alternatives, perhaps indicating difficulty with metaphors. However, because both literal and metaphorical interpretations are visually depicted in these tasks, and thus available as referents, choosing literal alternatives does not provide clear evidence against metaphor understanding. Instead, these findings could suggest that children privilege literal information when available.

If the goal of metaphor comprehension tasks is for children to pick metaphorical interpretations, then providing evidence that the literal interpretation is also afforded in those scenarios confuses that goal. As such, removing these literal options may allow for a better understanding of children's ability to access metaphorical meaning. In a recent study, Pouscoulous and Tomasello (2020) replaced literal alternatives with distractors (objects matched on relevance and visual salience) and found 3-year-olds could comprehend novel metaphors. Children in their study were given two toy cars—for example, one with a large bag on its roof (metaphorical) and one with a similar bag inside (distractor)—and asked to "Pick the car with the backpack". Children overwhelmingly chose metaphorical over the distractor alternatives, demonstrating that even 3-year-olds can access metaphorical meaning. What this study does not show, however, is whether providing literal options impedes this understanding. Adapting the Pouscoulous and Tomasello (2020) method, we investigate whether 3- to 7-year-old children can understand a variety of novel attributional, functional, and psychological metaphors and whether this understanding is impeded when literal interpretations are made available. Children in our study will hear different metaphoric utterances and be asked to choose which of two images the utterances refer to. In Study1, children will be presented with metaphorical and distractor images, whereas in Study2, the distractor image will be replaced by a literal depiction (see Fig1 for an example). We predict that children will privilege metaphorical images over distractor (Study1) but not literal images (Study2).* If children select metaphorical images in Study1 but not Study2, then this may indicate a more general mechanism behind literalism than simply a deficit in figurative language (as similarly suggested in Falkum, 2022).

*This paper has been submitted as a Registered Report so data are still in collection and will be discussed.

## PC-003 Parent-child pedagogy across diverse cultural contexts

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Humans have adapted to diverse environments across the globe due to the transmission of cultural knowledge, skills, and practices (Boyd et al., 2011; Heyes, 2018; Tennie et al., 2009). Early parent–child interactions play a pivotal role in cultural learning (Csibra & Gergely, 2009). However, our understanding of parental teaching behaviors across diverse cultural contexts remains limited. In two large scale cross-cultural studies, we assessed parental teaching towards their 2- and 4-year-old children in a semi-standardized ecological setting (mealtime) and a standardized setting (using a novel test battery).

In study 1, we used a functional definition of teaching as behavior that evolved to facilitate learning in others (Kline, 2015) and observed parents and their two-year-old child (N = 106) in a standardized setting (mealtime) in five diverse cultural contexts (rural: Brazil, Ecuador; urban: Argentina, Germany, Japan). Detailed coding of parental teaching (8520 teaching events in 1898 minutes of interactions) revealed that five teaching behaviors (prompts to do or to stop something, abstract communication of knowledge, demonstrations, providing choices, negative feedback) occurred frequently (> 5%) in all contexts. At the same time, we found that the relative frequencies of these behaviors varied between contexts: Parents from the rural contexts frequently used prompts towards their children. Parents in urban contexts often used abstract communication, demonstrations, and the provision of choices. We also identified nuanced differences between the urban samples regarding parental demonstrations (Japan) and the provision of choices (Germany). Our findings suggest that parents from all contexts mainly relied on a set of five teaching behaviors, but that there was cross-cultural variation in how frequently behaviors occurred.

In study 2, we implemented a test battery, consisting of 13 standardized tasks, to quantify children's lived experiences in the mother-child interaction (N ~250) across six diverse contexts across the globe, sampled for cultural diversity (rural Amazon region in Brazil, Mayan villages in Mexico, rural Uganda, urban region of Buenos Aires in Argentina, urban Germany, metropole region of Kyoto in Japan). We adapted key tasks from the developmental literature: We asked mothers and their 3-year-old children to cooperate (e.g., building a tower out of bricks), to solve a problem (e.g., a simple puzzle), to assign a task (e.g., bringing over objects), to innovate (e.g., generating ideas about unknown objects and shapes), or to make a choice (e.g., between presents). We coded maternal behaviors in each of these twelve tasks in detail (e.g., initiation and division of task engagement, parental structuring) and will use data driven classification (e.g., random forest analyses) to characterize similarities and differences in parent-child interactions across our six samples.

Taken together, our studies yield new insights, into how early cultural environments vary across

the globe, setting the stage for human culturally diverse developmental pathways. They provide us with a cultural map of children's early learning experiences, laying the ontogenetic foundation for human cultural diversity, and to provide us with a standardized tool for future research in this field.

## PC-004 Parenting Stress Mediates the Relationship Between Child Effortful Control and Technoference

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Effortful control, the ability to suppress a dominant response to execute a subdominant one, is one of the fundamental aspects of self-regulation (Rothbart et al., 2003). Parents of children with lower self-regulation report experiencing higher stress due to parenting (e.g., Abidin, 1992). Stressed parents report using their mobile phones more problematically (i.e., compulsively using and checking devices) and as a coping mechanism with stress (e.g., McDaniel & Radesky, 2018; Zhang et al., 2022). This problematic use of mobile phones may result in interruptions in parent-child interactions, in other words, technoference (McDaniel & Radesky, 2018a; Uzundağ et al., 2022). Technoference is associated with poorer outcomes in certain aspects of social and cognitive development such as behavioral adjustment and language (e.g., Carson & Kuzik, 2021; Sundqvist et al., 2020). Although past research showed the mediating role of parenting stress in the relationship between child behavioral problems and technoference, no study investigated how child effortful control is related to technoference via parenting stress and parental problematic phone use. In this study, we investigated whether parents of children with lower effortful control experience higher levels of parenting stress, which in turn leads them to engage in more problematic phone use and results in more technoference in parent-child interactions.

With an online survey, we collected data from 197 mothers of children aged between 36 and 86 months (M(SD) = 55.9(12.5)). Mothers filled in the Parenting Stress scale (Özmen & Özmen, 2012) and three subscales (i.e. perceptual sensitivity, attentional focusing, inhibitory control) of the Child Behavior Questionnaire assessing children's effortful control (Rothbart et al., 2001). Mothers further answered questions about their problematic phone use and the frequency of daily technoference experienced in parent-child interactions (McDaniel & Radesky, 2018a, 2018b).

Mothers of children with lower effortful control reported higher parenting stress ($\tau$=-.23, p<.001), more problematic phone use ($\tau$=.19, p<.001), and technoference ($\tau$=-.17, p<.01). A serial mediation model with children's effortful control as the predictor variable, parenting stress and parents' problematic phone use as the mediators, and technoference as the outcome variable was significant (F(5,188)=13.7, R2=.27, p<.001). As expected, parenting stress and problematic phone use (standardized indirect effect coefficient=-.04, SE=.02, 95% BCA-CI=-.08–-.13) mediated the relation between child effortful control and technoference when socioeconomic status, parental smartphone use duration, and children's screen time were controlled.

This study is the first to show that children's self-regulatory skills are related to technoference via parenting stress and problematic phone use. These findings suggest that parents may turn to their smartphones to cope with stressful aspects of child-rearing resulting in interruptions in parent-child interactions. Findings of this cross-sectional study contribute to our understanding of the relations between technoference and child- and parent-related factors and may provide avenues for longitudinal studies to assess the causal nature between these variables.

## PC-005 How familiarity of the model and the environment influences social learning: comparing overimitation in the lab vs. at home

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As many lab experiments have demonstrated over the past two decades, children imitate another person's actions even if those actions serve no causal function. However, it remains almost unexplored if this phenomenon, called overimitation (OI) is confined to laboratory situations and their particular features. The current study aims at closing this gap by exploring overimitation at children's homes with their parent as experimenter.
Four-to-seven-year-old children took part in a task resembling a typical OI experiment. Before the experiment, their mother or their father engaged in a two-week training to become capable of interacting as an experimenter with the highest possible degree of standardization. To start the experiment, they asked their child to retrieve a cookie from a transparent jar. Before it was the child's turn, the parent modelled an action sequence consisting of both, functional as well as non-functional actions on the jar. The sample of the study (N = 80) will be compared to a former collected sample (N = 80) in which children of the same age group participated in the same task at our lab interacting with an unfamiliar experimenter. Data analysis is planned to be finalized by November 2022. Results will be discussed with regards to how familiarity of the model and of the environment influence children's overimitation.



## PC-006 Exploring the Effects of Joint Action Observation on Children's Learning

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Joint actions, in which individuals coordinate toward common goals are critical for human social interaction and cultural transmission. Humans observe such actions on a daily basis, yet the underlying cognitive mechanisms and motivational processes supporting learning from joint action observation have largely been unexplored (McEllin et al., 2018). Indeed, most social transmission paradigms investigating how young children learn novel behaviors from others feature single model

demonstrations (ibid.). However, learning from alternative forms of interaction, such as joint actions, presents a unique challenge for novice learners as they need to simultaneously represent individual and shared goals when observing the action—that is, they need to actively track what each person is doing and how they are coordinating their actions in relation to the joint goal (Brownell et al., 2011; Tomasello, 2019). To address the question of how children imitate depending on the type of action they observe as well as on the presence of action coordination involved in performing such an action, we compare copying behavior following observation of individual and joint action sequences when such sequences involve causally irrelevant steps. Children observed individual agents or dyads operating a puzzle box to retrieve a hidden reward, and imitated the action either alone or with an experimenter. Preliminary results of our study with 3-6 year-old children suggest that imitation of causally irrelevant elements also occurs in the context of joint actions, where individuals are coordinating to perform the causally irrelevant step. Findings from this study provide insight into which features of the joint action play a key role in the successful transmission of cultural information and reveal a more nuanced role of the cognitive mechanisms which support learning from a wider range of social interactions.

## PC-007 From mind to mind: The relation between mothers' and children's theory of mind

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Theory of mind (ToM), the ability to understand one's own and others' minds (Premack & Woodruff, 1978), develops rapidly during preschool years (Wellman et al., 2001) and is a crucial skill related to social, emotional, and academic development of children (e.g., Astington & Pelletier, 2005). Parents' own ToM skills are likely to be related to their children's ToM both via genetic transmission and parental practices such as parents' mental state talk with their children. Up to date, only two studies examined the relationship between parents' and their young children's ToM and reported positive associations (Devine & Hughes, 2019; Sabbagh & Seamans, 2008). However, in these studies, children's ToM was either measured by only false-belief tasks or behavioral ToM tasks. Focusing on just one aspect (i.e., false-belief understanding) or one-time assessment of ToM (i.e., behavioral tasks) may not be sufficiently representative of the mental state understanding and everyday performance of children. Thus, we aimed to investigate the relationship between mothers' and their children's ToM by using both behavioral tasks and parental report to achieve a greater ecological validity. We expected a positive association between mothers' and their children's ToM.

We collected data from 41 mother-child dyads (22 girls, age range=48-68 months, M(SD)=56.4(5.1); data collection is ongoing). Mothers' ToM was assessed with the online version of the Reading the Mind in the Eyes Test (Baron-Cohen et al., 2001). Behaviorally, children's ToM was measured by the five-item ToM scale (Wellman & Liu, 2004) via videoconferencing. As an additional ToM measure, mothers filled in the Children's Social Understanding Scale (Tahiroglu et al., 2014), whose items

measure children's understanding of belief, knowledge, perception, desire, intention, and emotion on a scale of 1 (never) to 4 (always).

As expected, mothers' ToM scores (M(SD)=26(3.1)) and children's total score on the behavioral ToM tasks (M(SD)=2.6(1.3)) were partially correlated (τ=.25, p=.023) controlling for children's age. On the other hand, children's ToM measured by maternal report (M(SD)=2.7(0.4)) was not significantly related to mothers' ToM (r=.22, p=.16) and children's behavioral ToM performance (τ=.16, p=.13). Age was positively associated with the performance on behavioral tasks (τ=.26, p=.029), but was not related to ToM assessed with maternal report (r=-.12, p=.46).

Our findings suggest that mothers who are better at understanding others' minds have children who perform better on behavioral ToM tasks. This relationship may be mediated by the frequency of mothers' use of mental state terms when talking with their children – a possibility we are investigating in the current data set (the coding of the maternal mental state talk is ongoing). The lack of significant relations between maternal report of child ToM and other measures may suggest that mothers may be under- or overestimating their children's mind understanding skills.

## PC-008 Developmental relations between manual dexterity and mathematical cognition

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Empirical studies reveal a positive relationship between motor and cognitive development (e.g., Wassenberg et al., 2005), as predicted by classical theories of human development (e.g., Piaget, 1968; Vygotsky, 1997) and contemporary theories of embodied cognition (e.g., Abrahamson & Lindgren, 2014). Yet the extent and nature of relationships between motor skills and cognitive abilities remain under-explored (e.g., Grissmer et al., 2010; Oberer, Gashaj, & Roebers, 2017). To contribute to this research area, the present study employs a cross-sectional design to explore the development of motor-cognitive relationships.

To examine whether and how motor skills and (more formal) mathematical knowledge co-develop, we focused on 81 children at the cusp of formal schooling (age 6), 81 children at the start of formal schooling (age 8), and 96 children a few years into formal schooling (age 10). Through structured task-based interviews, we measured the development of fine motor skills and mathematical knowledge with age-appropriate standard test batteries. We expected a positive relationship between fine motor skills and mathematics throughout the development. We also expected the relationship to change over time—specifically, for the linear correlation to become weaker with age as overt actions become increasingly internalized.

Bayesian correlations were used to measure the relationship between fine motor and mathematical skills. We report the Pearson correlation coefficient (r) and the Bayes Factor (BF), using raw scores to preserve the variability of children's skills (see Figure 1). A pattern emerged in the fine motor and

math task associations. In Kindergarten, we found a positive relation between fine motor skills of the dominant hand and basic numerical skills. In 2nd grade, fine motor skills—now of the nondominant hand—related positively to addition, subtraction, and sequences. By 4th grade, however, the analysis found no meaningful relations between fine motor skills and mathematical knowledge.
Thus, we observed the expected decrease in the relationship between motor skills and math ability with age. Unexpectedly, we also found that the relation of children's fine motor skills to mathematical knowledge appears to dovetail with the natural developmental trajectory of handedness. That is, work on handedness indicates that children's reliance on the preferred hand emerges early, but drops from age 10 onward, with diminishing performance differences between the two hands (Scharoun & Bryden, 2014). The present results thus suggest an apparent parallel between the developmental trajectory of handedness, particularly the skills in dominant and nondominant hand fine motor manipulations, and the positive relation of fine motor skills to mathematical development in ages 6–10. This result provides a novel insight into the relationships between motor and cognitive skills and presents a potentially fruitful avenue for future educational interventions.

## PC-009 Teaching Problem-Oriented Thinking and Project Cycle to Children from Disadvantages Neighborhood through Voluntary Young Adults

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The vision of Turkey Educational Volunteer Foundation (TEGV) is to be an NGO accessible to every child in our country with its effective and distinctive educational programs and sustainable structure. Volunteers are necessary and extremely helpful for this vision. Current project, run by TEGV in partnership with Bank of America (BofA), aims to train young people between 18-25 at Y.O.D.A (Youth Online Design Academy) program. Volunteers were administered a full-day "Problem-Oriented Thinking and Project Cycle" training. Webinars on sustainable development were delivered. After the training and webinars, the volunteers developed projects on real-life problems they chose. In the next phase, volunteers became children's mentors to help them detect real-life issues, find solutions, and produce projects. 1656 young people participated in the webinars. 447 of them were selected for training. 70 volunteers met 690 students in 12 cities. A phenomenological inquiry method that searched for the essence of the interviewee's lived experiences was used to enrich the data about the impact of training and webinars on volunteers. Although not all participants could not finish the program for various reasons, TEGV, in partnership with BofA, reached to 1656 young people. COVID-19 pandemic, along with all difficulties brough some new perspectives to our lives. Extensive use of online programs is one of the many new perspectives. With online programs, it is easier to reach more diverse groups. However, keeping them engage on an online platform might be more difficult than face-to-face programs. During the interviews Y.O.D.A. program's online feature became both advantage and disadvantage. Volunteers, especially one who work, used online meetings and virtual workplaces for their occupations missed some webinars because it was burden

for them. On the other hand, the venue-independent online program was also an incentive for the ones who have busy schedule. To some extent, volunteers' personal and occupational lives might explain dropouts. During the program, various topics were offered as webinars, and participants met with experts from different fields. Diversity in webinars was shown as a strong advantage of Y.O.D.A. However, variety in topics were considered by some participants as losing focus, ending with dropouts according to survey results. Considering 447 participants who finished their trainings and webinars and produced 206 individual and 98 team projects, Y.O.D.A. is successful disseminating problem-oriented thinking and project cycle perspectives to young adults. The second level achievement was evaluated based on the progress in children's problem-solving skills and creativity. Children who attended program statistically significantly improved their problem-solving skills and creativity. Children's problem-solving skills and creativity levels were also improved for both gender groups. Even though the increase in males' problem-solving skills was not statistically significant, the increase was practically significant (Cohen's d=0.38). The effect of the 6-week program on children's creativity was dramatic, especially for females. Statistical findings were supported by interview results too. Overall analysis also showed statistically and practically significant impact of the program on students' problem-solving skills and creativity. To sum up, we have sufficient evidence that shows impact of the program on young adults and students.

## PC-010 Background Television and Child-Directed Language Input: A Home Observation Study

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In homes with young children, television is often on in the background even though no one is actively watching (Lapierre et al., 2012). Background TV is negatively related to children's vocabulary (Masur et al., 2016); a relation that may be mediated by reduced parent-child interactions. Indeed, previous experimental studies showed that the amount of child-directed speech produced by parents decreases in the presence of background TV (e.g., Kirkorian et al., 2009). Current literature on the relations between background TV and parent-child interactions relies on experimental findings in laboratory settings or parental reports. Home observations are needed to examine infants and parents in their natural settings, where parents can decide on whether or not and how to use screen media. To date, there is only one observational study showing that in homes of young children, adults talk less when the TV is on (Christakis et al., 2009). Thus, the present home observation study is the first to examine the relations between background TV and the quantity and quality of maternal language input directed to infants at 8, 10, and 18 months of age - a period highly susceptible to the effects of screen media (Corkin et al., 2021). We expected the presence and amount of background TV to be negatively related to the quantity and quality of maternal language input.

Forty-five infants and their caregivers were observed and video-recorded for 60 minutes at home at

8, 10, and 18 months. Background TV was defined as TV watching as a secondary, not primary, activity of children. Video recordings of home observations were coded by three independent coders for the presence and duration of background TV using the ELAN software (Lausberg & Sloetjes, 2009). Verbal interactions were transcribed offline in CHAT format. The number of total words (quantity measure) and the number of different words (quality measure) in mothers' speech directed to their infants were computed with the CLAN software (MacWhinney, 2000).
Mothers had lower scores in the quantity and quality measures of maternal language in the presence of the background TV compared to the absence at 8, 10, and 18 months (for quantity: $t(33)=2.37$, $p=.02$; $t(31)=2.81$, $p=.008$; $t(25)=2.74$, $p=.006$; for quality: $t(33)=2.58$, $p=.01$; $t(31)=2.61$, $p=.01$; $t(25)=2.66$, $p=.01$, respectively). At 10 months, both the quantity ($r=-.46$, $p=.007$) and quality ($r=-.44$, $p=.009$) of language were negatively related to the amount of background TV, whereas, at 8 months, only the language quality was negatively associated with the amount of background TV ($r=-.36$, $p=.03$).
Our findings suggest that background TV disrupts the quantity and quality of maternal language input directed at infants, crucial predictors of children's language development (Anderson et al., 2021). Adding to previous lab-based observations and parental reports about the negative effects of background TV, these findings show parent-infant interactions with reduced quantity and quality when screens are used passively at home, a more naturalistic setting.

## PC-012 Moral Attitudes Towards Humans and Other Animals Across Diverse Societies

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The moral standing humans grant other animal species critically determines how they treat them and can, ultimately, be a matter of life and death. The ontogeny of such moral hierarchies is affected by social learning. However, it remains unclear how variable these moral attitudes towards nonhuman animals are and develop across diverse cultural settings. This study investigates how 5-9-year-old children and adults from five culturally diverse sites assign moral standing to humans and nonhuman animals. Specifically, we assess to what extent participants morally prioritize humans over other animals (i.e., display a pro-human bias) and morally differentiate between food and companion animals (i.e., show a moral divide). Based on the analysis of previously conducted interviews, we select those study sites that maximally differ regarding people's perceived differences between humans and other animals. In the study, participants are asked to rank humans and representatives of food and companion animals according to their moral worth. Afterward, participants are confronted with a series of tragic trade-off dilemmas. Here, they must choose between saving a certain number of food and companion animals or humans. Data collection will start at the end of this year and will be completed in 2023. To our knowledge, this study constitutes the first approach to capturing the development of human moral attitudes toward other animals in a systematic cross-cultural comparison. It thus helps to shed light on the nature of moral cognition underlying human-animal relations.

## PC-013 The Emergence of Collaborative Behaviour: Insights from Kinematics

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The ability to work collectively towards a shared goal is one of the most striking human skills. Collaborative activity emerges in the first years of life and involves two or more partners coordinating their intentions and actions. Recent studies showed that kinematics during collaborative activity can reveal a person's hidden cognitive state. For example, adults have different kinematic patterns when they compete compared to when they collaborate on the same task. Moreover, adults' kinematics is sensitive to their partner's attitude when performing a joint task. There is a growing body of research that links the kinematics of movement to cognition, yet very little is known about how the kinematics of collaborative behaviour emerges over development. Here, we aim to (1) examine the emergence of motor markers for collaborative behaviour and (2) test how a partner's attitude impacts those markers. We tested school-aged children (6- to 10-year-olds; n = 14) in a reach-to-grasp Block game while wearing motion trackers to record their moment-to-moment kinematics. In the task, children were asked to build a two-block tower in collaboration with an adult partner. This version involves coordinating a reach-to-grasp movement with the partner's action. In some trials, the adult partner demonstrated a competitive attitude. As a baseline, we also measured children's kinematics in the same task without any partner. Findings show that partner's attitude during collaboration influences children's intention to collaborate, and this effect is captured in several kinematic features, including movement time, wrist velocity and height, and grip aperture. Although more data is needed to establish motor markers for collaboration, our findings provide insights into the origins of pro-social behaviour and how they relate to human movement.

## PC-014 The relationship between informational masking and dichotic listening; a developmental study

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In recent years, more attention has been paid to children with hearing difficulties. This difficulty, which often overlaps with developmental disorders, is termed auditory processing disorder (APD), and its occurrence rate is about 7% (Musiek et al., 1990).

Contrary to popular belief, children do not always have better hearing than adults: Children are poor at selective listening. Their listening ability in the presence of other sounds, such as a teacher's voice in a noisy classroom, is slower to develop. For example, in an informational masking task where target sounds are presented with distractor sounds having some acoustic or linguistic structure, the correct response rate for ages around 7 was almost 0%, whereas it was close to 60% (Contra-Speech Condition, target/distractor = -8 dB, Fig. 3 of Wightman and Kistler, 2005). Children also show lower

percentages of correct responses than adults in a dichotic listening task where different speech sounds are presented to each ear simultaneously. It is known that participants can listen to the speech presented to the right ear better than that to the left ear, especially if the task is difficult (Kimura, 1963). This phenomenon, called right ear advantage, is particularly evident in children (Hugdahl, Carlsson, and Eichele 2001). These two tasks, informational masking and dichotic listening tasks, simulate daily hearing situations that everyone experiences.

However, it is still not fully understood why children's selective listening develops slowly. The relationship between APD and the slow development of listening is also not known. Thus in this study, the two types of tasks, informational masking and dichotic listening tasks, were administered to the same participants to clarify the relationship between the hearing abilities underlay these tasks. The tasks were administered to children in multiple age groups to clarify the developmental characteristics of the hearing abilities as well. They were Japanese, and the stimuli were Japanese.

The results showed that the percentage of correct responses increased with age in the information masking and dichotic listening tasks, but in different ways. This suggests that the hearing abilities involved in each task mature differently (see poster for detailed analysis). Even for school-age children, the percentage of correct responses was lower than for adults, which is consistent with results from other language areas. Future work will include developing a test about selective listening for Japanese.

## PC-015 Assessing children's understanding of actions in an overimitation task

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Background and Aims:

Previous studies have consistently demonstrated that children engage in faithful imitation of causally irrelevant actions, despite visible evidence that they are superfluous to the task at hand. Most studies examining this 'overimitation' focus on explaining the child's motivation for completing unnecessary actions. In this study we examine what children learn from engaging in overimitation by asking children to rate how 'sensible' or 'silly' the actions were either prior to, or after, completing an imitation task. If children learn through overimitation, we predict that they will be better-able to discern sensible and silly actions after having the opportunity to imitate.

Method:

The method and analyses for this study were pre-registered on the Open Science Framework. Fifty-nine five-to-eight-year old children (26 female) were randomly assigned to either a question-first or an imitation-first condition. In each of six trials, children watched an experimenter open a simple puzzle box and retrieve a toy using a sequence of necessary and unnecessary actions. Puzzle boxes were simple Tupperware containers that had been decorated to increase novelty. In the question-first condition, children were instructed to rate the actions on a 5-point scale from 'sensible' to 'silly'. Following the rating task, children were handed the box and instructed to retrieve the toy for themselves. In the imitation-first condition, the order of the latter two tasks were switched, so children

retrieved the toy and then rated the actions subsequently. Ratings of the actions and imitation of the unnecessary actions were recorded for analysis.

Results:

Discrimination scores were calculated on each trial, by subtracting the rating of the necessary action from the rating of the unnecessary action. There was no overall difference in the discrimination scores between the question-first and the imitation-first conditions ($p = .18$). There was also no condition difference in the amount of overimitation recorded ($p = .17$). However, the interaction between condition and overimitation significantly predicted discrimination scores on a trial-by-trial basis ($p = .0003$). In the question-first condition, children behaved in accordance with their action ratings – they only imitated on trials where they were not able to discriminate between necessary and unnecessary actions. In contrast, in the imitation-first condition, discrimination scores did not differ between trials where the unnecessary action was imitated or not.

Discussion:

When prompted to think about the necessity of the actions prior to acting, children only engaged in overimitation when they were uncertain about an action's causal relevance. We believe that questioning children in this way changed the nature of the task and prompted rational behaviour. In contrast, when children were given the opportunity to imitate first there was not such a tight coupling between their understanding and their behaviour. This could reflect a learning process in which children improve their discrimination of necessary and unnecessary actions following imitation. Alternatively, the lack of questioning could result in imitation for reasons other than causal errors. These results will be discussed in relation to the Dual-Process model of overimitation (Schleihauf & Hoehl, 2020).

## PC-016 Neuro-cognitive predictors of early language development

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Healthy human infants brought up in a functional family learn to understand and produce speech. However, the developmental trajectory of language acquisition shows considerable variance. Can we predict the quality of language acquisition from measures taken from preverbal infants and their mothers? Predicting infants' quality of language acquisition has widespread prospective societal benefits, because it allows early detection of potential developmental problems. Interventions are typically more effective the earlier they commence due to the higher plasticity of the developing brain. From genetic inheritance to socioeconomic status a large number of variables affect language acquisition. We took an intermediate-level approach measuring infants' electric brain responses to speech stimuli at critical time points together with behavioral measures, medical and socioeconomic data. We followed infants from birth to 18 months, measuring their EEG response to speech. In parallel,

we also assessed the phonetic properties of mothers' speech as it develops with the child Outcome measurements were 18-months receptive and expressive language scales of Bayley Scales of Infant and Toddler Development (3rd ed.) (n=66) and the MacArthur-Bates Communicative Development Inventory (n=86). We have acquired data from newborns (n=75), 4-month-olds (n=114), 6.5-month-olds (n=94), and 9-month-olds (n=85). The participant numbers reflect the additional recruitment at 4 months of age extending the sample of the newborn recruitment.
For analysis we took a data-driven approach putting a large number of input variables into a complex cross-validated statistical model predicting the outcome variables. Results show that our model can identify a relatively small subset of variables that consistently predict language outcomes at a moderate level.

## PC-017 Persistence, Executive Functions, and Academic Achievement: A Longitudinal Study

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Introduction. In the classroom, self-regulation demands are manifold. Staying on task, avoiding distractions, or working independently require good self-regulation skills. Separate research lines suggest that persistence and Executive Functions (EF) play a crucial role in academic development. However, persistence and EF have rarely been studied jointly, and it thus remains unclear whether these two constructs contribute to intellectual development independently. To address this gap, we assessed both EF and task persistence in kindergarten and examined the long-term effects on second-grade academic achievement (i.e., mathematics and reading). Our hypotheses were the following: We expected that EF in kindergarten would predict academic achievement in second grade. Furthermore, we expected that beyond the effects of EF, persistence would also predict second-grade reading and math skills. Multiple regression analyses were computed to examine the association between EF, persistence, and academic skills.
Methods. A total of N = 88 children (51 % female) participated in the longitudinal study. At the first measurement point, children attended kindergarten (mean age: 6.1 years, SD = 0.3 years). At the second measurement point, children had transitioned to primary school and attended second grade (Mean age: 7.9 years, SD = 0.3 years). At the first measurement point, children completed a behavioral persistence task (i.e., Puzzle-box task, Eisenberg et al., 1996) and a battery of EF tasks. A sum score of inhibition, shifting, and working memory was used in the analysis. At the second measurement point, teachers rated the children's math and reading competencies.
Results. The regression analysis showed that after controlling for gender ($\beta$ = -.08, n.s.), EF ($\beta$ = .25, $p < .01$) significantly predicted math skills. Beyond the effects of gender and EF, persistence ($\beta$ = .31, $p < .01$) also predicted second grade math skills. Overall, the model explained 19% of the variance in math skills. Results for reading competencies revealed a different picture. The regression analysis showed that after controlling for gender ($\beta$ = .03, n.s.), EF ($\beta$ = .33, $p < .01$) was the only significant

predictor of second grade reading skills. Beyond the effects of gender and EF, persistence (β = .18, n.s.) did not substantially predict reading. Overall, the model explained 17% of the variance of reading. Implications. Gaining a precise understanding of precursors of intellectual development is essential to design interventions to support children in attaining their full academic potential. The present results suggest that the ability to persist plays a meaningful role beyond cognitive control processes, particularly in developing mathematical skills.

## PC-019 Using automated video tracking to investigate how friendship influences preschoolers' spatial association patterns during unrestricted playtime

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Preschool children spend large parts of their daily lives in groups of peers, where they are embedded in a complex web of social relationships. Relationships between peers mediate their social interactions on a day-to-day basis and promote individual social and emotional development. Reliably and accurately capturing the social dynamics in peer groups has been a major challenge for researchers interested in early peer interactions. Friendships are among the most relevant of these early relationships. Friendships between peers are characterized by frequent social interactions and close physical proximity. The detection of such spatial association patterns is a highly valued measure in the social sciences, especially when examining naturalistic interactions. Traditionally, video coding by one or multiple observers is being used as a means of objective observation. However, researchers struggle with this effortful type of data collection, because it is extremely resource-consuming, especially when employed in naturalistic settings. Moreover, observational methods are error-prone and subject to interpretation bias, particularly when observing complex movements and interactions. Recent advances in computer vision and deep learning facilitated the development of software tools that allow tracking the position of subjects in videos in an automated way. In the present study, we used the commercial video analysis and tracking software Loopy (loopbio.com) to track association patterns of small groups of preschoolers during unrestricted playtime. We hypothesized that children's proximity and interactions patterns would vary with their friendship status and that we would be able to accurately detect these patterns with automated video tracking.

Eleven groups of three children between 3 and 6 years of age (M=3.95 years) were allowed to play freely for 10 minutes in a room that contained toys in various locations. Prior to the observation we asked the children individually about their preferred play partners to measure which children were friends and which were not. Each group contained one pair of mutual friends and a third child that was a non-preferred play partner for both other children (i.e., non-friend). The children wore differently colored caps with three black marker dots to facilitate tracking. The children were video recorded with a GoPro camera mounted on the ceiling in the center of the room. After an initial an-

notation phase, where a subset of the videos was annotated manually, the software used a deep learning algorithm that enabled automated tracking of the caps and their specific markers. We used the children's position in the room to calculate their proximity to each other and their interaction patters. Preliminary results show that friends were closer to each other than non-friends and interaction patterns differed as a function of friendship status. Automated video tracking promises to be an efficient tool for monitoring children's social relationships in naturalistic settings and will increase replicability within- and across institutions and contexts.

## PC-020 A Self-Initiated Spatial Working Memory in Children 4-6 Years Old

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Developmental working memory (WM) studies have been focused almost exclusively on memory tasks in which children had no control over the content of the representations they memorized. In contrast, in everyday life, as children develop they begin to shape the content of their memory representations themselves as do adults. We recently began to study this aspect of memory, we termed self-initiated (SI) WM. Initially, we studied the spatial aspect of SI WM in young adults, using a modified spatial span task, in which participants memorized spatial sequences they constructed themselves. The results demonstrated that adults created structured spatial sequences that followed well-known Gestalt principles of organization. Memory for the SI sequences was enhanced compared to memory for random or structured sequences that were not SI. Subsequently, we showed that children 7-10 years old, were as efficient as young adults in constructing spatially structured sequences that enhanced their memory performance. Thus, from age 7children have metacognitive knowledge on the spatial structure of efficient spatial WM representations, which they utilize when constructing spatial SI WM representations.

In the current study we explored the performance of preschool children 4-6 years old, in spatial SI WM. In non-SI WM, several studies have shown that children as young as 4 years old benefit from memorizing structured visual representations based on Gestalt organization cues. Nevertheless, children at this age may lack the metacognitive knowledge on the structure of spatial WM, and lack the ability to utilize this knowledge to construct structured representations that will benefit memory performance. Twenty-one children 4-6 years old performed a modified computerized spatial span task. In each trial participants were presented with an initial array of 14 randomly distributed pictures of drawers, and with a varying number of pictures of 3-5 teddy bears (which represented the memory load). During encoding, the children placed the toys within the drawers, and were asked to memorize the locations of the filled drawers. In the SI condition, children selected the to-be memorized drawers (i.e., locations) themselves, by clicking the chosen drawers in sequence. In a control, non-SI condition, children clicked on the drawers which were randomly chosen by the computer. Following a short delay of 2500 ms, the children were asked to retrieve the locations according to the same order of encoding. The results showed that overall, accuracy increased with age, as 6

years old children performed better than children 4-5 years old. All children were less accurate in memorizing order, compared to memorizing the locations themselves. Importantly, across all age groups, children created structured spatial sequences in the SI condition, and showed enhanced performance in the SI condition than in the non-SI condition. As far as we know this is the first study that examined how preschool children create their own spatial memory representations. This study indicates that children as young as 4 years old, have access to the metacognitive knowledge on the spatial structure of WM, which enables them the flexibility to create spatial representations that benefited memory performance.

## PC-021 Effects of social exclusion on infants' behavior and neural processing of emotional faces

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Social exclusion is a very aversive feeling that threatens important psychological needs such as self-esteem and belongingness (Williams & Nida, 2011). It has been shown that social exclusion often induces considerable physiological (Bass et al., 2014), cognitive (Kawamoto et al., 2014) and behavioral (Bourgeois & Hess, 2008) changes in adults. However, little is known about children and infants' response to self-experienced social exclusion. The aim of the study is to explore whether the condition of being included or excluded during a ball tossing game can influence 13- to 14-month-old infants' behavior during the game and their neural processing of emotional faces. To do so, we implemented a live version of the Cyberball Game (Williams et al., 2000) in which 28 infants participated being either included (N=14) or excluded (N=14) while playing with two experimenters. The Cyberball phase was videorecorded to assess whether infants' behavior was affected by being excluded as compared to included. After the exposure to the Cyberball game, event-related potentials (ERPs) were recorded in response to the observation of faces dynamically expressing anger, fear and happiness. Results exploring behavioral reactions revealed that social exclusion influences infants' involvement and behavior during the Cyberball game. Furthermore, analyses on ERP data revealed a faster P1 to happy faces in the exclusion vs the inclusion condition. In addition, in the inclusion condition angry and fearful faces elicited faster responses compared to happy expressions, while no significant differences emerged in the exclusion condition. Data collection and analyses are currently ongoing, however, current preliminary findings demonstrate that social exclusion has a direct impact on infants' behavior and also influences their neural processing of emotional faces. The implications of the current findings for our understanding of the role of early social interactions shaping the processing of emotional faces will be further discussed.

## PC-022 Using Augmented and Virtual Reality technologies to investigate active learning in spatial environments

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Active learning and exploration behavior have primarily been investigated using real-world behavioral paradigms or simple computer- and tablet-based games. On the one hand, behavioral paradigms may not be fully flexibly customizable by the experimenter, a disadvantage that computer-based games can mitigate. On the other hand, computer or tablet use is not fully naturalistic, as it often provides only a partial reconstruction of the richness of the 3-dimensional world around us. This may limit the ecological validity of findings about self-directed learning behavior, especially in spatial navigation contexts. Turning to Augmented (AR) and Virtual Reality (VR) technologies may help us strike a balance between these two problems by ensuring the trackability of behaviors unfolding in stimulus-rich, highly interactive and dynamically customizable environments. Our study aims to shed light on the methodological possibilities in AR and VR for developmental research on active information search and learning.

In a lab-based experiment, we investigated how 5-12-year-old children (N=46, 23 females, Mean age=8.28 years) and adults (N=39, 22 females, Mean age=36.59) spontaneously search for objects in a simple environment. Specifically, we explored different age groups' subjective experiences and preferences when they engage with different technologies, and how they search for objects in various task environments. The participants played an egg-search game in which they had to collect and hatch virtual eggs that contained animals. The eggs appeared one at a time and could be hatched by directing the participant's gaze to them. The task was implemented on four platforms, varying in their degrees of the participants' immersion in a virtual environment. Participants played in 1) a 2-dimensional tablet environment, 2) an augmented tablet environment, with AR software projecting the eggs onto the participants' surroundings, 3) a fully immersive AR environment, viewed through a Hololens headset, and 4) a fully immersive VR environment using a HTC Vive headset. We collected questionnaire data on the participants' subjective experiences with each device used and registered their continuous spatio-temporal movement coordinates while they collected eggs. Data were analyzed as a function of the technology used, participants' age, and their experience ratings. Both children and adults rated the immersive VR setup to be the most enjoyable and exciting. Presence in the AR and VR environments were rated as more natural than in a 2D tablet environment, although these between-condition differences decreased with age for adults but not children; and children rated all games generally more immersive than adults. Mean egg collection times were the shortest in the 2D condition for both age groups, with VR being the second fastest condition. These preliminary results suggest that using AR and VR methods seems an engaging new avenue for addressing children's active learning capacities in spatial environments, as they provide natural and immersive task contexts. In further studies, we plan to use AR and VR technologies to examine the development of multiple-cues learning strategies in a self-directed spatial exploration context.

Overall, our study provides methodological suggestions for developmental scientists' practical decision-making in the domain of active learning research.

## PC-023 Higher infant surgency related to better linguistic outcome at 18 month

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Temperament is a set of biologically determined features which can be identified in early childhood. These temperamental features contribute to affection regulation, attention direction, and motor activity (Rothbart, 1981, 2007). Previous studies have found that early positive temperament traits (eg., infants' attentional control and the capacity for self-regulation) correlate with the efficiency of language acquisition (e.g., the time of appearance of first words and the time and speed of vocabulary expansion) during the first 2 years of life. (Canfield and Saudino, 2016, Dixon and Shore, 1997; Dixon and Smith, 2000). Others found a positive correlation between inhibition and expressive language (Smith, et al. 2014). Larson et al. (2020) with the involvement of typically developing children and children with specific language impairment found that inhibition skills may help to improve subsequent morphological comprehension.

Our longitudinal study aimed at investigating the relationship between infant temperament and language development at 18 months.

We hypothesized that longitudinal association can be found between early infant temperament and later language development. Infant temperament at 6, 9, 18 month was assessed by the Very Short Form of Infant Behavior Questionnaire and Very Short Form of Early Childhood Behavior Questionnaire. Language competence at18 months was evaluated with The MacArthur Communicative Development Inventory. Surgency at 9 and 18 months and effortful control at 9 months correlated with receptive language score at 18 months. Infants with higher surgency and effortful control score showed better language understanding skills. Infants with higher scores on the surgency scale may enter into communicative situations more readily and show more engagement with adult social partners. Furthermore infants with higher effortful control may more easily direct and maintain their attention in a communicative situation.

## PC-024 Children's use of others' knowledge and ignorance as cues to social group membership

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Others' psychological attributes such as their beliefs, preferences and knowledge can give powerful cues about their social identity and history (e.g., Soley & Köseler, 2021; Velez, Bridgers, & Gweon, 2019). Here, we examine the role of what people know and what they don't know in guiding children's social inferences about them. The role of children's own knowledge state and different types of knowledge (i.e., culture-specific vs. general) were also examined.

Seven- and 8-year-old children (N = 100, 50 female, Mage = 8.02, SD = .53) were tested online via Zoom. Children were shown targets who were knowledgeable or ignorant of familiar and unfamiliar knowledge items, and asked to guess what language targets would speak. Items were about culture-specific (e.g., food or national flag) or general (e.g., shape of earth) knowledge. Half of the culture-specific items were familiar items that are specific to participants' culture and the other half were items that belonged to an unfamiliar culture. Similarly, half of the general items were familiar, widely known facts (e.g., the favorite food of rabbits) and the other four were unfamiliar facts (e.g., average daily sleep duration of cats). Participants were asked whether the targets would speak their native language or a made-up foreign language.

Data were analysed using GLMM with binomial distribution and a logit link function. Results showed that both 7- and 8-year-olds used others' ignorance as well as their knowledge to make judgments about targets' language. Specifically, 7 and 8 years-old children expected that if targets shared their knowledge state (e.g., both the participant and the target were knowledgeable or ignorant), they would speak their native language. However, when targets were knowledgeable about unfamiliar items or were ignorant about familiar items, children inferred that targets would speak a foreign language. Further, inferences based on knowledge were stronger than those based on ignorance, and culture-specific items yielded stronger inferences than general items. Finally, social identity judgments of 8-year-olds were more sensitive to their own and others' knowledge states and type of knowledge compared to 7-year-olds' responses. These findings contribute to our understanding about children's sensitivity to others' epistemic states, the social implications of such sensitivity.

## PC-025 Do turn-timing changes in non-native language?: A study with a 3-year-old child

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A tight temporal coordination can be observed in human conversation. A study that examined 10 languages across cultures showed that the tight temporal coordination is universal in adults' con-

versation; the speech turns (i.e., turn-timing) occur within a range of 250 ms (Stivers et al., 2009). These rapid turn-timing develops during childhood, and it reaches to 500 ms at the age of 3 years in mother-child interaction (Casillas et al., 2016). In this study, we examined whether and how the children's turn-timing changes depending on the language competence. As a preliminary exploration, we studied a 3-year-old child interacting with a bilingual adult experimenter in a free-play context. ABA experimental design was introduced as follows: In the first 15 min, the experimenter used Japanese which is the first language for the child (native language condition). In the next 15 min, the experimenter switched to Korean which is naïve language to the child (non-native language condition). In the last 15 min, the experimenter switched back to Japanese (native language condition). Referring to the previous studies (Stivers et al., 2009; Casillas et al., 2016), we restricted the comparison to question-answer pairs in the data analysis. The experimenter's questions were first categorized into two types: polar questions (questions that expect a yes/no answer) or non-polar questions. Then, the child's answers were coded into either yes/no answer or other phrases answer. Preliminary results showed that the child's answer types did not significantly changed between the native and non-native language conditions: To the experimenter's polar questions, the child answered with either yes/no or other phrases with no clear differences. On the other hand, to the experimenter's non-polar questions, the child tended to answer with other phrases (more than 80%). This suggests that the child actively utilized contextual cues to understand the experimenter's communicative intentions regardless of the language competence. In the poster presentation, we will further show whether the temporal aspect of child's responses (i.e., turn-timing) would change depending on the language competence, and how it may change as the number of experimental sessions increases.

## PC-026 Is children's subjective intention understanding related to their counterfactual reasoning?

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How do children develop an understanding of the subjective reasons and intentions with which rational agents act? Intentions can be subjective in the sense that an agent does many things simultaneously ("moving her mouth", "eating a cookie") but the intentionality depends on the aspect or description under which she acts (e.g., Anscombe, 1957; Searle, 1983). For instance, if she falsely believes there are more cookies, she may be eating the cookie on purpose, but not intentionally under the description "eating her roommate's last cookie". However, if she knows this but accepts that her roommate will be angry, she may be intentionally eating the last cookie, but not intentionally annoying her roommate. The situation might be different if she can't stand her roommate: she is acting with a malicious intention to annoy her roommate by eating the last cookie.

To understand why the agent acted the way she did we thus need to take into account the subjective perspective of the agent (her beliefs, desires and resulting intentions) from which the action makes rational sense. From the point of view of cognitive development, the crucial question is how

this form of subjective action understanding and interpretation develops.
While earlier in development children have a basic grasp of intentional action (e.g., Gergely et al., 2002; Woodward, 1998), other research incorporating the aspectuality of intentions found comparatively late onsets for understanding the subjectivity of intentions (Kamawar & Olson, 2011; Proft et al., 2019; Schünemann et al., 2021).
The question remains why children find it difficult to ascribe subjective intentions. To fully understand that an agent performed an action that is both A-ing (eating a cookie) and B-ing (annoying her roommate), yet only performed it intentionally under the former and not under the latter description, one has to understand counterfactuals of the following kind: Had there been an option to perform A without performing B, the agent would have done so. But had there been an option to B without A-ing, the agent would not have chosen that option.
One untested possibility so far is thus that children's understanding of the subjectivity of intentions shows a protracted developmental trajectory because it is related to (the slowly developing) capacities for counterfactual reasoning (e.g., Kominsky et al., 2021; Rafetseder et al., 2021; Redshaw & Suddendorf, 2020).
In this study, children between the ages of 4.5 to 8 years (N = 93) were tested in three conditions (false belief, side-effect, bad motive) in which each agent acted intentionally under certain descriptions. Preliminary results indicated that performance on counterfactual reasoning tasks, but surprisingly not on subjective intention comprehension tasks, improved with age. Performance on the intention task was predicted by children's performance on the counterfactual reasoning tasks, but this effect disappeared when controlling for condition effects. Children in all age groups performed well in the false belief condition and significantly worse in the side-effect and bad motive conditions. Results will be discussed in light of cognitive processes underlying children's reasoning about intentions.

## PC-027 Eco-cultural influences on the ontogeny of elective flexibility and related executive functions

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Flexible thinking and behavior are core components of human ingenuity. From as early as five years of age, children are proficient in flexibly responding to cues or feedback in order to adopt a new strategy when a previously successful one stops working. However, the developmental trajectory underlying elective flexibility, the ability to replace a functional strategy—for instance, with a more efficient one—is less clear. Elective flexibility is critical when navigating dynamic environments, but deciding when to switch away from a working strategy is complex. We propose that the propensity to electively switch strategies is tuned to meet the demands of one's environment. Specifically, ex-

posure to unpredictable variability in daily activities and subsistence increases elective switching, while exposure to harsh environments (i.e., high consequences of strategy failure) reduces elective switching, regardless of variability. The current study investigated the ontogeny of elective flexibility and related executive functions in children and adults (ages 3-81) in three communities: urban Germans (n = 169, n female = 86), Congolese Bandongo fisher-farmers (n = 92, n female = 43) and Congolese BaYaka foragers (n = 69, n female = 32). Participants completed (i) a Four-Armed Bandit decision-making task, (ii) a Corsi Block-Tapping memory task, and (iii) the Early Childhood Inhibitory Touchscreen Task. Additionally, German participants completed (iv) a Color-Shape Shifting task. We also assessed each community's exposure to variability, predictability, and harshness in daily activities and subsistence using GPS tracking (Congolese participants only) and interviews. We found evidence that elective flexibility becomes more skillful (e.g., results in better payoff) with age, but that this is mediated by task-difficulty and the use of meta-strategies like 'stick with one selection' or 'select all options in rotation.' We discuss the associations between executive functions and elective flexibility across the lifespan; specifically, the relationship between cued and elective switching in the Color-Shape Shifting and Four-Armed Bandit tasks, respectively. Finally, we contextualize our findings by discussing how cultural and developmental variation in elective flexibility reflects cognitive adaptations to variability, predictability, and harshness in one's eco-cultural environment.

## PC-028 Infants infer agent-specific competence by assuming efficiency of goal-directed actions

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Action costs vary across action types (e.g., walking 500 m may be less energetically costly than swimming 500 m) and agents (e.g., walking may be less costly for a human than for a duck, as well as it may be less costly for a healthy person than for someone recovering from a surgery). The information about how costly different actions are for different agents is not given away by the agents' appearance. Instead, it must be inferred based on their behaviour by assuming that they perform efficient (i.e., cost-minimizing) actions for particular goal states. Across two eye-tracking experiments (N = 16, replication: N = 40), we investigated whether 10-month-olds can carry out such inferences. Specifically, we tested whether they can compute agent-specific action costs by making sense of the agents' behavioural choices. Infants were familiarised to two agents, A and B, overcoming obstacles to reach their target located on the other side of the stage. The agents acted individually: A systematically jumped over low obstacles and walked around high obstacles; B jumped over both low and high obstacles. At test, both A and B were present while their target was now located on a mid-height or low-height platform. We measured infants' predictive gaze towards A and B, who stayed motionless throughout the trial. In the mid-height platform condition, infants looked longer at B, while in the low-height condition platform condition they looked equally to A and B. This pattern of results indicates that (1) they worked out that jumping bore little cost for B, while jumping

high was high cost for A (i.e., higher than detouring obstacles), and (2) used this motor competence judgements to predict the agents' actions in a new environment. These findings suggest that basic building blocks competence evaluations are available in infancy and may be rooted in infants' action interpretation skills.

## PC-029 Where should I look? Comparing preferential looking at 9 months based on others' linguistic and racial group

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Within the first year of life infants begin to construct representations of social categories such as language and race. For example, 3- and 5-month-old infants prefer to look at same-race people and at speakers of their native language when paired against people of an unfamiliar racial or linguistic group. However, previous studies have typically investigated the effects of distinct social categories on infants' behavior independently. Whether infants consider race and language information similarly or differently to guide their looking preferences remains unknown. Furthermore, past studies on infants' preferential looking have typically used static stimuli (i.e., faces), but people are intentional agents who are constantly performing actions. How are infants distributing their attention in such dynamic situations? Here, we assessed infants' looking preferences toward individuals from a familiar social category versus individuals from an unfamiliar social category. We manipulated language (Experiments 1 and 2) and race (Experiment 3). In addition, infants were tested in a looking preference task that included both static events (still faces side by side) and dynamic events (people side by side performing the same actions). In Experiment 1 (language), 32 9-month-old infants looked similarly at native-language and foreign-language speakers both in static and dynamic trials. However, exploratory analyses indicated a significant preference for the native language speaker during the most critical period of the action, namely, when the agents were grasping their toy. Experiment 2 replicated the looking preference for native-language speakers during grasping with a new group of 32 participants (pre-registered). Finally, Experiment 3 manipulated the agent's race and found a different pattern of looking preference. Sixty-four 9-month-old White infants preferentially looked at an other-race agent (Black or African American, or East Asian) versus a same-race agent (White) both in the static and dynamic conditions. We concluded that distinct mechanisms underlie 9-month-old infants' looking preferences across different social categories. The finding that infants preferred to look at people who previously spoke their native language, but only in cases in which they were performing relevant actions, suggests that in Experiments 1 and 2 infants considered information conveyed via speech to identify culturally relevant informants. In contrast, the general preference to look at other-race people found in Experiment 3 suggests that infants' looking preferences were driven by perceptual processes. For example, as proposed in previous studies, a greater ability to process same-race faces could allow infants to allocate more time to process other-race faces, or similarly, it could induce a preference for faces that are more perceptually novel.

## PC-030 Beyond dichotomies: Dissecting the WEIRD bias in mainstream developmental science

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Developmental psychology research faces a serious generalizability issue. The vast majority of research published in the field's flagship journals (and at scientific conferences, such as the BCCCD) relies on participants from culturally-peculiar convenience samples: those that are Western, Educated, Industrialized, Rich and Democratic (i.e., WEIRD; Henrich et al., 2010). However, the WEIRD acronym encourages dichotomized thinking, with researchers often classifying their populations as sitting inside or outside this descriptive boundary. This practice severely limits our understanding of who is currently represented in developmental psychology. To combat this, we conducted a systematic review of the five top-tier developmental and cross-cultural psychology journals during the years 2016-2020 (N = 2698 empirical articles). For each article, we coded the number of participants sampled, their representing countries, and how impactful these publications were (judged by citations). We recorded the variables of interest and examined participant samples on a range of culturally-relevant dimensions, including individualism, cultural distance and educational system. Our results reveal that Nielsen and colleagues' (2017) call to rectify the field's sampling bias has largely been ignored. While across the five journals participants were sampled from a total of 94 countries, the overwhelming majority of participants are still representative of WEIRD samples: coming from the United States, the United Kingdom, Germany and Canada. Many of these studies do not measure culturally-relevant variables alongside their primary variables of research interest (such as cultural group, SES or bilingualism). Only 28.2% of these articles report the participant's cultural group in the abstract, and only 77% report the country in which the data was collected. Those that do report participants' country are less likely to have high impact (judged by citations). And only 11.2% of studies sampled participants from two cultural contexts concurrently (N = 302 cross-cultural studies). This snapshot suggests the field must undergo drastic systematic change before we can gain a holistic picture of the breadth of human behavior across diverse developmental and cultural settings.



## PC-031 Intervening factors in the investigation of scalar implicatures during typical development: a systematic review

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The present work is a review on the acquisition of scalar implicatures in typically developing children, done through a systematic methodology. The references were selected through the PRISMA method. The criteria for eligibility were that the articles should be peer-reviewed, published articles written in English, containing empirical data on the comprehension of scalar implicatures in first language

acquisition during typical development. Furthermore, there needed to be a clear classification of the type of implicature being tested and the task, the authors needed to have performed a replicable statistical analysis on the data and there needed to be indication of the age range and mean age of the participants. Finally, the results had to be given in terms of percentage of success in implicature derivation (or a measure that could be converted to this), to allow for comparisons.

The aim of this review is three-fold. First, to provide a picture of what empirical data tells us about the acquisition of scalar implicatures, based on both lexical and ad-hoc scales, potentially contributing to theoretical accounts of the phenomenon. Secondly, to analyse the methodologies that have been used to test children, as well as the factors that intervene in whether or not children succeed in this task. And lastly to evaluate whether or not systematic review is an accurate analysis method for this type of varied and often complicated data.

In the end, 44 papers were deemed eligible for the analysis, all published between years 2001 and 2021. Within these references, a total of 158 different findings in terms of percentage of success was obtained, summing up the different experiments, implicature types, tasks and groups tested within the 44 references. The minimum age tested was 2 years old and the maximum age tested was 13 years and 4 months old. Six different task types were used within the dataset: action-based, communicative context assessment, felicity judgment, referent selection, speaker selection and truth value judgment.

The data analysis was performed using RStudio (R 4.1.0) in different ways: first, a Generalised Linear Model was fitted to analyse the data as a whole, inserting percentage of success as a dependant variable and mean age, task type and implicature type (lexical or ad-hoc) as independent variables. Then, non-parametric tests were performed at different stages of the analysis.

The results suggest that children improve in implicature derivation with age, especially with lexical scales, which are more difficult during the pre-school years. Furthermore, it seems that the task used to test children may have a considerable impact on how they perform with implicatures. What the literature suggests, in this case, is that tasks that do not rely on children's meta-linguistic or meta-representative abilities provide better results, and therefore action-based tasks might be better suited to test these inferences, especially as opposed to Truth Value Judgment tasks. The fact that the systematic analysis confirms previously individuated trends in the acquisition of implicatures confirms that this is in fact a useful methodology to analyse the data, even with its limitations.



## PC-032 The effect of categorical representation on memory recognition in children 6-10 years old

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Previous research has shown that knowledge structures like categories affect recognition memory (De Brigard et al., 2017). However, few paradigms allow the direct manipulation of category representation

to study their effect on memory performance in adults and children. The current research offers a novel experimental paradigm that allows manipulation of category representation to study the effects of category on recognition. The paradigm consists of two stages. In the first stage (categorical visual search), adult participants (N=30) and children ages 6 to 10 (N=67) searched for a target image to remember among five distractor images belonging to another category. The categorical visual search was organized differently: in the low categorical distinctiveness (LCD) condition, the target image (e.g., a dog) was surrounded by perceptually similar images, from the same superordinate category (e.g., cats); in the high categorical distinctiveness (HCD) condition, it was surrounded by dissimilar objects, from another superordinate category (e.g., images of lamps). After finding the target image, the participant had 3 sec to memorize it without displaying the distractor images. The experimental design was within-subject - each participant memorized 12 target images in the LCD condition and 12 target images in the HCD condition. In the final stage (Test), participants receive a recognition test that includes old images as well as new 24 images from these categories. We expected that because visual target detection is more difficult in the LCD condition than in the HCD condition, this would make participants more likely to activate their knowledge of the category to which the image belongs. This should lead to a distortion in remembering - a shift of the memory trace to the prototype (Lupyan, 2008) and the difference in recognition success should be determined not by the number of hits, but by false alarms: we expected more false alarms in the LCD condition than in the HCD condition. Our hypothesis was fully confirmed in adult participants. In children we expected that the effect of category representation on recognition should increase with age: younger children (6-7) should be less susceptible to this distortion from category representation, neither the number of hits nor the number of false alarms should differ in LCD and HCD conditions, than older ones (8-9year-olds). We found that the number of false alarms, hits, and d's in the LCD and HCD conditions did not differ in children 6-7 years old. However, at age 8-9, these differences in the number of false alarms appear. At age 10, this difference becomes the same as in adult participants. The difference in recognition was determined only by the number of false alarms, and the number of hits did not change with age. In this experiment we have shown how categorical representation affects recognition and how this affects increases with age. We intend to discuss the mechanism of recognition memory development in children, as well as the advantages and limitations of the proposed paradigm for younger children.
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## PC-033 Reasoning by exclusion at 19 months

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We investigate the scope and nature of disjunctive reasoning in 19 month old infants. The study probes the presence of logical processes in word-reference mapping. Oculomotor data show that disjunctive syllogism helps fixing the meaning of novel words in the Mutual Exclusivity (ME) tasks, displaying a double-checking pattern similar to that triggered by logical inferences in older children

and adults. Importantly, the same double-checking behavior appears when infants had to adjudicate the referent of two known words, suggesting that double-checking in ME is an instance of general processes of reducing uncertainty among alternative candidates, aided by logical reasoning. These behaviors appear in both bilinguals and monolinguals, indicating that even in word-related tasks logical reasoning does not depend on specific language acquisition experiences.

## PC-034 Association between mobile touchscreen device (MTSD) use and executive function, and socio-cognitive/ -emotional skills

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Excessive passive digital screen time (such as TV/ video watching) in early childhood is associated with a lower level of executive function and socio-cognitive skills, and emotion recognition. A few studies show that the impact of MTSD use on children's development is different from the effect of passive digital screen time since MTSD use enables interactivity, special sensorimotor stimulation (use of touchscreen), variability of activities, multitasking, and – most importantly – it is more frequently a more solitary activity compared to e.g., TV watching. However, only a limited number of studies investigated the association between MTSD use and executive function, socio-cognitive, and -emotional skills.

We conducted a comparative study on the association between time spent with MTSD use and the level of executive function, socio-cognitive, and -emotional skills in 4-year-old children. We also aimed to investigate whether this relationship is mediated by parenting style and parent-child joint activities. We hypothesized that the more time children spend with MTSD use the poorer their executive function, socio-cognitive, and -emotional skills are, and that this is mediated by lower parental responsiveness and fewer parent-child joint activities.

We recruited parents of 4-year-old children with various levels of experience with MTSD uses. Children's MTSD use, parenting styles, and parent-child joint activities were reported by parents in an online questionnaire. Children's executive function (inhibitory control), socio-cognitive (theory of mind), and socio-emotional (emotion recognition) skills were measured with standard cognitive tests online, via video call.

We expect our findings to bring us closer to the understanding of the association between MTSD use and children's executive function, socio-cognitive and -emotional skills, and how it is mediated by parenting style and parent-child joint activities. This cross-sectional study forms the basis of a longitudinal study that may be suitable for exploring causal effects.

## PC-035 Altercentric and Egocentric Biases in Level 1 & Level 2 Perspective-Taking Tasks

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Social cognition is subject to specific biases. Egocentric bias refers to the phenomenon that subjects are slowed down and led into error by their own perspective, even when explicitly asked to focus on others' perspectives (e.g., Samson et al., 2010). More surprisingly, recent studies provided evidence for an altercentric bias as well: our own judgments and behavior are modulated by how we think other agents perceive the world, indicating that we implicitly represent their perspectives, even when those are irrelevant or interfere with our own task (e.g., Southgate, 2020). In our upcoming study, we investigate both types of biases by using mouse-tracking measures. These measures have been used to document altercentric bias (e.g., Van der Wel et al., 2014): when subjects are asked to move the mouse cursor to the location of a target object, they take a little detour on their way to the correct answer when another agent in the scenario has a deviant belief. The area under this detour thus indicates whether/to what degree participants engage in altercentric bias.

The novelty of the current study is that it employs mouse-tracking measures to explore altercentric and egocentric biases in Level-I versus Level-II perspective-taking (PT) tasks. Whether and to what degree these widely automatic biases are found in different levels of PT tasks has theoretical implications. On the one hand, two-system accounts expect biases only in Level-I tasks capturing automatic System-I but not in Level-II tasks tapping effortful System-II. Therefore, if significant biases are found only for Level-I tasks in the current study, the results would support the dual-system approaches. On the other hand, nativism accounts assume unified PT abilities and predict no differences between the two levels of PT. Therefore, if biases occur in both Level-I and Level-II tasks in the current study, this would support the nativist approaches.

Participants will be randomly assigned to one of the two bias conditions in a mixed study design. In the egocentric bias condition, participants will be asked to judge the visual perspective of an agent who is looking at a table from the opposite side of the participant. In the altercentric bias condition, participants will be asked to judge what they themselves see on the table, but the agent will remain in the scene. Each condition will involve both Level-I and Level-II PT tasks. Within each level, there will be congruent versus incongruent trials, where the presented stimuli are respectively the same or different from the agent's and the participant's perspectives (Figure 1). After the presentation of the stimuli, participants will be offered two answer options: one correct and one incorrect (but correct from the irrelevant perspective in incongruent trials). If participants are subject to egocentric and altercentric biases, we expect them to draw a convex bow detouring toward the incorrect answer in the incongruent trials but not in the congruent trials as they include no perspective conflict.

One hundred English-speaking adults will be tested online in October 2022. The results will be discussed within the above-mentioned theoretical frameworks.

## PC-036 Visual engagement as a predictor of learning in young children

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Visual engagement has become a major driver behind media produced for children. Algorithms on YouTube Kids prioritize offering material expected to maintain children's attention for longer, as do those on other platforms designed for children like Roblox and Twitch. Visual engagement is also used in testing children's entertainment materials for suitability in promoting language development and literacy (e.g., Anggraini et al., 2022). In this literature, attention is commonly interpreted as resulting from the learning value of the given material. In fact, decades of work on children's attention has demonstrated that there are at least two sets of factors that contribute to visual engagement, one of one of which indicates informational utility (e.g., Kidd & Hayden, 2015). Children may visually engage because they are learning (e.g., Montessori, 1917; Kidd et al., 2012)—or they may visually engage because of low-level, perceptual attentional attractors like movement, high contrast, or saturation (Aslin, 2007). If we conflate high visual engagement with learning, we run the risk of concluding that children's television shows purported to be educational on the basis of high visual engagement metrics could actually be scoring high because of their stimulating perceptual content. Likewise, if edutainment production companies manufacture content designed to score high on visual engagement metrics without specifically testing whether children learn from said material, they have done children a disservice.

Despite the vast relevant literature on these topics, no work to our knowledge specifically tests whether increasing visual engagement through the use of perceptual attentional attractors like color, motion, and contrast could increase learning. Thus, we designed a study for this purpose. In our study, we present children (ages 2-5 years) with novel objects (toys) introduced with novel spoken labels (e.g., children see a small monster toy and hear "Oh, look at the biffle! What a nice biffle"). We expose children to 6 such word-object associations, in one of two randomized conditions. Either children hear the word-object associations with the object presented in an austere setting (on a gray background), or they hear them in a highly visually engaging one (on top of a colorful, attractive, moving video). Data collection with children is in progress, and will be complete within the next 6 weeks. Based on our piloting work, we anticipate that visual engagement as defined as total time of visual fixation on screen will be highest in the engaging condition, but that learning in this condition will be diminished as compared to the presentations with austere backgrounds. Even if we do not observe this expected trend in the full sample, however, we expect the outcome to be informative about the merits or potential perils of using visual engagement as a proxy for learning utility and educational value.

## PC-037 Tool creation triggers expectations about non-random structure creation in 14-month-olds

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For adults and children, the presence of an ordered array is diagnostic for the presence of intentional design. This has been confirmed by two distinct lines of studies. First, adults and even young children infer the past presence of an agent from changes caused in the environment. Past research has shown that infants by their first year expect human hands to create an ordered array (Newman et al., 2010) but show surprise when a mechanical object does so (Ma & Xu, 2013). Second, ordered arrays may take the form of an artefact, as the elements of the artefact's structure follow a plan crafted by the designer. Past research has shown that adults and children may take the perspective of the 'design stance' in order to evaluate artefacts. From at least six years of age children categorize and judge the function of an artefact based on the function intended by the original designer (Kelemen & Carey, 2006).rnIn this study we hypothesized that the creation of order and the creation of an artefact stem from the same ontological root and signal the competence of an intentional agent that can create a non-random structure. In our experiment using a violation of expectation paradigm we tested whether 14-month-old infants develop ordering expectation after witnessing a novel agent repeatedly building an efficient rake. The test scene, where the agent created disorder in contrast to the scene where it created order elicited longer looking times which suggests that for our participants the tool building behavior was compatible with the creation of order but was not compatible with the creation of disorder. This looking time pattern - dominant at beginning of the test phase – declined over the subsequent test trials: participants quickly accepted not only order but also disorder as a potential outcome of an intentional agent's actions.rnThese results reveal that infants consider the creation of non-random structures as a competence that generalizes from tool creation to a more abstract capacity of order creation without depriving the agent of the freedom to create disorder.rn

## PC-038 Modal concepts at the preschool: children reason about impossible cupcakes and necessary peppers

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Optimal decisions under environmental uncertainty require discrimination of outcomes that may, must, and can't happen. For example, taking a train that is guaranteed to have available seats is preferable to choose one that might be sold out. Conversely, anyone would prefer a vaccine that might not have a very unpleasant side effect to one guaranteed to have it. That is, a desirable and necessary outcome is preferable to a merely possible one, but if the outcome is undesirable, then just possible is better than inevitable!
Under a popular analysis of modal notions (Kripke,1963), necessity, possibility, and impossibility

are determined by logical quantification over alternative possibilities. In this framework, an event is necessary if instantiated in ALL possible outcomes, just possible when realized only in SOME of them, and impossible when it takes place in NONE. But when do children first develop the capacity to evaluate an option's modal status and make decisions based on it? Previous work has found that infants already form expectations about probable events that reflect the number of possible outcomes (TéglásEtAl., 2007, 2011). However, even three-year-old preschoolers struggle to prepare optimally for multiple, mutually exclusive versions of possible future outcomes (Redshaw&Suddendorf, 2016, Leahy&Carey, 2020).

To investigate the development of children's modal concepts, we devised a game where children (Younger: N=24, M=3.6yo; Older: N=24, M=4.7yo) had to choose between two options to maximize or minimize the chances of a desirable (a cupcake) or undesirable (a hot pepper) outcome. We used two side-by-side physical probability devices that each had three ramps and were constructed to produce a random trajectory towards any of those ramps each time we would slide down a ball. We manipulated the modal status of the outcomes by keeping the number and value of the "reward" the same (one on each machine) but blocking a different number of ramps on each device. We generated three types of trials with contrasting modals: necessary vs. possible_0.5, impossible vs. possible_0.5, and possible_0.3 vs. possible_0.5. For example, by blocking two ramps and having the third one lead to the cupcake on one side and blocking only one ramp on the other side while letting the second ramp lead to the cupcake and the third one to an empty bin, children were put in a position to choose between a necessary cupcake and a possible one. Preliminary results revealed that already at age 3 children successfully reason about necessary (MNecessaryCupcake=58%, MNecessaryPepper=8%, $p<0.05$) and impossible (MImpossibleCupcake=12%, MImpossiblePepper=95%, $p<0.05$) outcomes but, unlike adults, struggle to choose between two possible outcomes with different probabilities (MMoreprobableCupkake=50%., MMoreprobablePepper=25%, $p>0.05$). These results suggest that young children are sensitive to the modal status of outcomes and can flexibly integrate it with its value to make adult-like choices. Strikingly, children were struggling with probabilities when both were only possibilities. This result is consistent with modal concepts rooted in logical forms of quantification (i.e., in ALL, SOME, NONE of the possibilities), a proposal we are currently testing in a follow-up study.

## PC-039 Individual differences in infants' social evaluations across cultures: A spin-off project of Many-Babies 4

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Infants prefer prosocial over antisocial characters (e.g., Hamlin et al., 2007). However, individual differences exist in this preference, as shown in several behavioral tasks and studies of brain activity, while perceiving others' prosocial/friendly or antisocial/threatening behaviors (e.g., Margoni & Surian, 2018). In this poster, we will introduce a spin-off project of the Many-Babies-4, examining individual differences in infants' social preferences by using a large sample of infants from diverse cultural contexts in relation to (1) their caregivers' moral-related characteristics, expectations, and everyday socialization activities, (2) the cultural context in which the infant is being raised, and (3) infants' prosocial behaviors outside of the lab. Using a multi-method approach (experimental, observational, and survey-based measures), findings from this work will help us understand the roots of individual differences in infants' social preferences, as well as culturally-shared and -unique patterns of development.

In this study, we provide an overview of our measures and a new coding protocol that has been developed to capture variation in parental moral and mental state talk in a joint-book reading (JBR) task (e.g., Shimizu et al., 2018). Moral talk included evaluation or description of prosocial or antisocial behaviors (e.g., "Helping is a good behavior", "He helps the other child"), evaluation of prosocial or antisocial traits (e.g., "He is a good boy"), and instructive talk about prosocial or antisocial behaviors (e.g., "You should help others"). Mental state talk included description of the mental states of the characters in the book (e.g., "Why is he thinking that?") and references to the child's own mental states, including emotions, cognitions, desires/intentions (e.g., "Does this make you sad?").

Pilot data included 43 infants (NTurkey = 24, NChina= 16, NUSA= 3; Mage = 11.82 months, SD = 5.10, Range = 4-23 months). Using a one-way MANOVA, we compared Turkish and Chinese parental talk in the JBR task while controlling for child age, child gender, parent gender, caregiver education level, book reading frequency and social game playing frequency (see Figure 1). Overall, Turkish parents had less antisocial talk than Chinese parents ($F(1, 25) = 11.58$, $p = .002$, partial $\eta 2 = .32$). Specifically, Turkish parents had fewer descriptions of antisocial behaviors and less instructive talk about antisocial behaviors than did Chinese parents ($F(1, 25) = 4.48$, $p = .044$, partial$\eta 2 = .15$ and $F(1, 25) =$

11.64, p = .002, partialη2 = .32, respectively). In terms of the child's own mental state, Turkish parents referred more to their child's own cognition (knowledge states or beliefs) and less to their child's own emotionally-bound behaviors than Chinese parents (F (1, 25) = 7.01, p = .014, partialη2 = .22, and F (1, 25) = 5.15, p = .032, partial η2 = .17, respectively). There were no significant differences in Turkish and Chinese parents' prosocial talk. The findings suggest that the coding protocol captures variability in parental moral talk across cultural contexts. We will discuss how this project provides an example of how to maximize the impact of large-scale projects by asking new questions.

## PC-040 Do Dynamic vs. Static Presentation of Stories Affect Narrative Skills in Children: Differential Effects of Working Memory, and Parental Talk

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Narrating requires reconstruction and shows variations in children (e.g., Conway, 2005). Several factors are associated with narrative skills, such as task type (e.g., static vs. dynamic, Diehm et al., 2020), linguistic ability (Merritt & Liles, 1987), and executive functions (Daneman & Carpenter, 1980). Narrative skills can be linked to neonatal status due to preterms (PT) being at risk of cognitive and language delays (Sansavini et al., 2010), which are important in narrative production. Although the role of cognitive skills is well documented, the cause of asymmetry in the presentation of stories has not been investigated. Task demands might require different cognitive mechanisms or parental support. Hence, we investigated (i) whether children's narrative skills (narrative structure, word count) and parental talk (word count) differed according to task type and (ii) how neonatal status, working memory, and parental talk were associated with narrative skills in different tasks. 37 parent-child dyads (Mage=48.15 months, SD= 1.19) participated in cartoon-retelling (dynamic) and storytelling (static) activities in an online study. In cartoon-retelling, children watched a cartoon about two octopi for 1.5 minutes and retold the story after the cartoon ended. In storytelling, children were shown five pictures of the Late for School story (Gillam & Pearson, 2004) and described what was happening in those pictures. The dyads' conversations and narrative productions were transcribed verbatim to code children's narrative ability. Children's narrative structure was coded based on whether children produced temporal relations, causal relations, agents' goals, the medium of achieving goals, and the results of the actions (Demir et al., 2015). We calculated children's and parents' word count. We assessed children's working memory by the Turkish Word Span task (Adıgüzel, 2021) consisting of backward and forward trials and expressive language skills by the Turkish picture-vocabulary task (TIFALDI) expressive (Berument & Güven, 2013). First, neither children's nor parents' word count differed according to task type (F(1,28)=.078,p=.78, F(1,28)=.68,p=.41, respectively). Besides, interactions between word counts and control variables were not significant. Children's narrative structure scores did not differ across tasks (F(1,26)=.049,p=.82). However, there was a significant interaction between task type and forward span (F(1,26)=4.702, p=.039). Second, narrative skills are

differentially associated with parental talk and working memory. Children's backward span was only related to children's word count in static (r=-.372,p=.025) but not in the dynamic task (r=-.036,p=.83). Parents' word count was positively correlated with children's word count in both tasks (r=.439,p=.008; r=.529,p<.001; respectively) yet negatively correlated with children's narrative structure scores in the static task (r=-.411,p=.016). Children's neonatal status and narrative skills were not associated. Our findings indicate no association between children's narrative skills and task type. However, differential associations with WM might reflect different cognitive skills underlying narrative skills for each task. Furthermore, differential associations of parental talk with children's narrative skills might pinpoint the differences in narratives' quality and quantity.

## PC-043 Information Structure as a Cognitive Heuristic in Development

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Information Structure articulations, such as topic-focus and presupposition-assertion (1), constitute the building blocks to adopt cognitive heuristics, meaning top-down processing strategies aiming at maximising efficiency (Müller 2018; Lombardi Vallauri 2021).

(1) Mary visited the Louvre [Assertion][Topic] when she was pregnant [Presupposition][Focus].

Adults tend to regulate the amount of attention they pay to different portions of the utterance depending on a linguistic 'flagging' system. They usually pay more attention to asserted and/or focal information, and less attention to presupposed and/or topical information (Hornby 1974; Sanford 2002 a.o.). This meshes well with the linguistic theory as presupposition and topic are deemed to be linguistic packaging strategies for content with lower informative prominence while assertion and focus are associated to content with higher informative prominence (Vallduví 1993; Cresti 2000; Lombardi Vallauri 2009; Simons et al. 2010 a.o.). Moreover, presupposition and assertion also appear to impact on how people store a certain even in their long-term memory. Specifically, presupposition is more effective than assertion in shaping people's memorial representations (Loftus 1975).

In order to become successful participants to communication, children have to learn to 'structure information', i.e., to regulate their attentional resources and create memorial representations grounding on linguistic packaging. However, little is known about whether, and how, children learn to do that. This study aims to address this topic. On Week 1, 109 7-year-olds, 109 11- year-olds and 90 adults (L1: Italian) watched a short video and then listened to 20 sentences about it. For each of them they had to decide whether it was 'true', 'false' or they 'didn't know'. The targets conveyed a misrepresentation of the video (e.g., the presence in the video of a basket which was actually not present) through a topical presupposition (The basket under the sink was not touched), a focal presupposition (Under the sink the basket was not touched), or an assertion (Under the sink there was a basket, and it was not touched). A week later (Week 2), participants were tested again in the same modality but without having the possibility of watching the video again. This time, the target sentences contained only assertions, which encoded the same misrepresentations as in Week 1. Because of the pandemics,

the experiment was carried out online on Google Meet. Data was analysed thought linear models. Results indicate that information packaging impacts on misrepresentation recognition and on the creation of memorial event representation in both adults and children, although in different ways. Overall, adults appear to be more influenced by presupposition-assertion articulation when processing information, as they more easily noticed a mistake when presupposed than when asserted. On the contrary, topic-focus articulation seems to have a greater impact on children's responses, possibly because focus is prosodically marked (Selkirk 1984 a.o.). Considering that it is the main stress of the utterance to signal the focus, this might lead to an easier-to-capture form (main stress)-meaning (informative prominence) pair.

## PC-044 18-month-old infants can extract the gist of a scene

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Our visual environments contain complex information, including a variety of surfaces and objects that observers recognize as coherent and meaningful scenes (e.g., "a park" or "a kitchen"). Adults can extract such conceptual information from scenes known as "scene gist," after viewing images for as little as 20 milliseconds. However, little is known about the development of scene processing and whether young infants encode conceptual information from visual environments they encounter daily. In the present study, we investigated whether 12- and 18-month-old infants are already extracting and encoding conceptual information from familiar scenes. In two eye-tracking experiments, we used a preferential-looking task to see if infants could categorize mealtime and playtime scenes based on their gist.

In Experiment 1, we tested 12-month-olds (N = 23) and 18-month-olds (N = 23). The experiment consisted of 12 trials, in half of which we familiarized infants with mealtime and, in the other half, with playtime scenes. In each trial, infants were presented with three different exemplar images of scenes from the same category (1 sec each). Following familiarization, two images of scenes were presented simultaneously for 5 seconds in the test: one from the same and the other from the novel category. Both test images were new exemplars of their respective category, but were chosen to be perceptually similar (e.g., in colors, viewpoint). After repeated exposure to one type of scene (e.g., 'mealtime'), we expected infants to look longer at the scene with a different gist (e.g., 'playtime'). We computed a ratio of the total fixation duration to the novel in contrast to the familiar scene in the test. In Experiment 1, we found no preference for the novel scene category at test in either age group (12-month-olds: M = 0.49, SD = 0.05; 18-month-olds: M = 0.51, SD = 0.07).

In Experiment 2, we tested whether language would aid scene-gist extraction, similarly to how it aids object categorization. The design was the same as in Experiment 1 except that during familiarization, a pseudo-word was played for each scene category (e.g., 'mize' for mealtime and 'pádu' for playtime). In the test, no labels were used. Whereas 12-month-old infants (N = 23) showed no significant preference for the novel scene category (M = 0.49, SD = 0.05), 18-month-olds (N = 23) looked significantly

longer at the novel scene category (M = 0.54, SD = 0.06) compared to chance (t(22) = 3.33, p = .003, d = 0.79, 95% CI = [0.51, 0.56]).
In Experiment 2, 18-month-olds were able to categorize scenes when images were presented with labels during familiarization. Labels helped 18-month-olds but not 12-month-olds in extracting high-level conceptual commonalities, i.e., gist, from the perceptually different but conceptually related images of scenes. Since infants could only use conceptual information to distinguish between images during the test phase, our findings show for the first time that infants can extract the gist of scenes.

## PC-045 The cognitive development of deaf and hard-of-hearing children: Studies on Theory of Mind, executive function and language

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Previous research suggests that the late language acquisition of deaf children of hearing parents (DHP) causes the developmental delay in the ability of mindreading in deaf children compared to neurotypical peers. However, there is no difference in the development of ToM between deaf children of deaf parents (DDP) and hearing children of hearing parents (HHP). Studies with HHP also show positive correlation between executive function (EF) and false belief understanding. In case of DDP and DHP no differences in EF was found despite of the differences in ToM performance.
In our ongoing study we aimed to examine the correlation between ToM, EF and language ability in a Hungarian sample of DDP, DHP and HHP.
We applied a story sequencing task and the Theory of Mind Scale to measure ToM abilities, along with four tasks to measure EF (spatial working memory: Corsi block, inhibitory control: Go/No Go task, cognitive flexibility, shifting: verbal fluency, CCTT). We also tested all children's language ability with a vocabulary task.
When comparing DDP and DHP performance on the EF tasks, we found no significant differences between groups. Although there was a significant difference between deaf and hearing children's performance in the Go/No Go task.
Considering the story sequencing task, age as a covariate was significant in all story types, and family background (e.g. language exposure) was marginally significant. Though in relation to hearing condition, we found no differences in the performance of the groups. Deaf children performed similarly on the Theory of Mind Scale as hearing children regarding the developmental sequence.
Our preliminary results are in line with previous studies. Although, we found significant difference in inhibitory control between DDP, DHP and HHP. Thus, the differences in inhibitory control might be mirrored in the differences in ToM performance between groups.

## PC-046 Selective teaching: Do children transmit generalizable or specific information to naïve social partners?

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Children are not only effective learners, but also actively teach others what they know – and do so selectively with respect to information type and its recipients. As such, previous research suggests that children tend to share information that is generalizable to a kind ("dogs have fur"), rather than specific ("this dog has spots"). However, systematic investigations of such preference are lacking and it is unknown whether such generalisability preference is retained when information is not neutral. Using a novel interactive online paradigm, we aim to first conceptually replicate previous findings and extend this line of research to investigate knowledge transfer in salient and health-related domains. We expect a disruption of generalisability preference, which would have implications for our understanding of children's reasoning and social behaviour when dealing with – and propagating – health-related information, a topic especially significant in the context of the recent pandemic. The proposed research programme thus aims to advance our understanding of children's selective sharing of different types of information.

In the current study, we aimed to conceptually replicate previous findings that children share generic information preferentially about neutral topics such as familiar animals. We designed a novel paradigm to test children online using a social, interactive, live multi-media presentation. Children aged 6-9 (data collection ongoing; planned N = 36; current n = 28; Mage = 7.33) were tested in four trials comprised of learning and transmission phases. In each trial, they first learned two generic and two specific facts about a familiar animal (dogs and birds), with one fact at a time presented in a counterbalanced order. In the subsequent transmission phase, children were introduced to a friendly cartoon alien – Zarpie, a naïve learner eager to learn about our world – and were asked to teach Zarpie any of the facts learnt by sending them an envelope with the selected fact. We coded the first shared fact and the total number of generic and specific facts transmitted to a naïve learner as complementary measures of information transmission preference. Preliminary findings indicate that children had a preference for transmitting generic facts (on average across four trials, 19 children chose generic and 9 taught specific facts as their first choice, with on average 1.77 generic facts out of all facts transmitted per trial vs 1.39 specific facts) and older children (8-9-year-olds) were more likely to systematically share generalizable facts across all four trials. This study therefore conceptually replicates previous reports of children's preference for teaching generalizable facts and validates a novel paradigm designed in the spirit of fostering accessibility and generalizability of findings. We will next extend this line of research into a non-neural, salient, and health-related information transmission. Since no single standardised, reliable, and ecologically valid procedure has been developed to investigate selective teaching in children, our systematic investigation of different types of information using a novel paradigm will contribute to both theoretical and methodological developments in research on social knowledge transmission.

## PC-047 The emergence of self-perspective presents infants with a challenge when self and other perspectives conflict

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The current study investigated whether the emergence of cognitive self-awareness is a factor in young children's capacity for perspective tracking. A recent hypothesis proposes that self-awareness allows for representation of the self-perspective, which, when it diverges from the other's perspective, presents a challenge for perspective tracking because one representation must be prioritized over the other (Southgate, 2020). In work under review, we presented 50 18-month-olds with a novel perspective conflict task and showed that experience of conflict, as indexed by pupil dilation, was indeed greater in infants who demonstrated mirror self-recognition (n = 25) than those who did not (n = 25). In a second ongoing study, we further investigate this question by asking whether infants who demonstrate self-awareness at 18 months would exhibit greater activation of brain regions implicated in conflict processing (Fiske et al., 2021), when presented with an event high in perspective conflict. To test this, we presented another group of 18-month-olds (n = 64, preregistered) with a similar perspective conflict scenario and measured change in pupil diameter and the hemodynamic response over midfrontal, and right frontal cortex as measured with fNIRS, as indices of conflict processing. In both studies, conflict is manipulated by presenting trials in which infants do and do not know the actual location of an object (high and low conflict, respectively). In exploratory analyses, we also examined the relationship between oxytocin, self-recognition, and conflict processing. Data collection for the second study will be completed by the end of 2022.

## PC-048 Children and adults believe intellectually humble tendencies are virtuous in intergroup contexts

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People often feel strong allegiances to their ingroups' belief systems, leading them to dismiss divergent viewpoints. Although intellectual humility (and more specifically, receptivity to alternative beliefs) is typically considered to be an epistemic virtue, it is unclear how this trait is evaluated in intergroup contexts. In a preregistered study, we investigated whether 6- to 9-year-old children (n = 98) and adults (n = 62) from the United States evaluate information-seeking and belief change––two key components of intellectual humility––as condemnable or commendable in novel intergroup situations, when adopting a new belief would reflect a departure from the factual or moral beliefs held by ingroup members. Findings indicated that 84% of children and 89% of adults believed that it is praiseworthy to curiously seek out information about outgroups' divergent factual and moral beliefs.

Additionally, 63% of children and 84% of adults believed that it is praiseworthy for others to change their beliefs to match an outgroup's beliefs when faced with compelling evidence. However, while 80% of adults thought it would be bad to retain existing beliefs in the face of conflicting evidence, only 39% of children judged belief stasis to be bad, suggesting a major developmental shift in evaluations of belief fixedness. Finally, 83% of adults and 62% of children believed that, upon discovering evidence supportive of an outgroup's belief, people should tell their fellow ingroup members that the outgroup's belief is correct. Overall, our data indicate that children and adults praise intellectually humble tendencies in third-party intergroup contexts.

## PC-049 Information as a reward: a gaze-contingent study of information-seeking in 12-month-old infants

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Infants are incredibly skilled learners who do not merely absorb information passively but play an active role in learning: they direct their attention to stimuli that are neither too easy nor too difficult to learn (1,2); turn their gaze to an adult when unsure which item a word refers to (3); explore toys that behave in unexpected manners (4); and gesture towards novel objects with the expectation of receiving information (5). The mechanisms governing these active information-seeking behaviours however remain poorly understood. One influential theory posits that information seeking behaviours are guided by the inherently rewarding aspect of obtaining information (6). Here, we propose to investigate this idea longitudinally in 1-to-2-year-old infants, with the aim of 1) bringing evidence that infants value information as rewarding and can disengage from rewarding stimuli in order to gain information, 2) establishing the stability and variability of information seeking over the second year of life.

100 infants will be included in this experiment as part of a larger longitudinal study of learning and curiosity in infants, with visits at 12, 18 and 24 months of age. Preliminary results from 20 12-month-old pilot participants will be analysed and presented at the conference. This experiment is an adaptation of a paradigm originally used in primates and based on the idea that given a system that values information itself as rewarding, agents should be willing to pay for information by trading rewards such as food, even when gaining information does not incur any additional reward, and this willingness to pay for information should scale with the potential information gain (7). Here, infants will be familiarised with different characters (Fig. 1a), each associated with an engaging animation (a proxy for food rewards in primates), and indistinguishable when partially occluded (Fig. 1b). In test trials, these characters will be partially hidden in boxes and infants will be able to reveal the characters through gaze-contingent eye-tracking. Importantly, only fixating on the first box will trigger an animation, whereas gazing at the second box will only reveal the static character. Infants will thus have to pay a cost of disengaging from the ongoing animation in order to gain information on the identity of the second character. Moreover, the information gained through the second fixation will

be manipulated by the number of different characters present prior to hiding (thereby making the identity of the second character more or less ambiguous).
The number of trials in which infants reveal the second character as well as the speed at which they do so will be compared across conditions of varying information gain. Furthermore, pupil dilation prior to reveal will be examined as a physiological marker of expected information gain (8). We predict that if infants' behaviour is motivated by considering information as rewarding, they should be willing to disengage from the on-going cartoon to reveal the identity of the second character, at a speed and likelihood that should scale with the potential information gain. Pupil dilation is likewise predicted to scale with information gain.

## PC-050 Do children show spatial lateralization in an ordinal/spatial task? A pilot study with three-year-old children

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Multiple studies have demonstrated that human and non-human animal species organize and represent numerical information according to a specific left-to-right spatial orientation (Dehaene, Bossini e Giraux, 1993; Rugani, De Hevia, 2010). While this was thought to be a product of culture (Shaki, Fischer & Petrusic, 2009), recent studies demonstrated that even populations without formal education spontaneously organize and represent quantities on a left-to-right oriented mental number line (Di Giorgio et al., 2019; West & McCrink, 2021). Accordingly, recent studies have shown that preschool children use a left-to-right oriented searching strategy in a spatial/ordinal task in which they had to retrieve a target stimulus hidden under the 2nd, 3rd, or 4th cup out of ten horizontally aligned cups (Rugani et al., 2022).
Our study adds to this research line by investigating kindergarten children's spontaneous ordinal/spatial representation with a particular interest in the possible presence of a lateralization (asymmetry) effect and the variables that might influence it.
Participants (n=25, mean age=43,38 ± 3,59 months) were asked, through four trials, to help the experimenter find a target item that was always hidden under the second of six cups aligned in a sagittal arrangement in front of them. Successively, the experimenter covered and rotated the arrangement by 90° keeping the position of the six cups and the target unchanged. To investigate spatial lateralization, the experimenter inserted a target under the second cup on the right side as well. Children also completed a battery of domain-specific and domain general tests including counting, enumeration, spatial attention and language.
A preliminary analysis showed high variability among the sample. Only a portion of the children (N= 12) displayed an asymmetrical preference, and the remaining chose the central cups (either the 3rd or the 4th). Children who chose the right 2nd cup responded best to the enumeration task. We investigated whether this effect was influenced by the handedness, but no statistical differences

were found F (2, 22) = 1.79, p = .190. The ANOVA revealed no effect of left or right preference on counting F (2, 20) = 0.621, p = .547, spatial attention F (2, 22) = 2.208, p = .134, language F (2, 22) = 2.208, p = .134 and home numeracy F (2, 22) = 0.452, p = .642.
These preliminary results suggest that spatial-numerical association showed important individual differences in preschool and that cultural artifacts do not strongly influence children's preferences at this age.

## PC-051 Impact of Maternal Pregnancy-specific Anxiety on Young Infant's Self-Regulation Development: A prospective longitudinal Study

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INTRODUCTION
Self-regulation is a fundamental precondition for mental and physical health as well as overall life success. As self-regulation includes the ability to monitor and manage thinking, attention, emotions and behavior in a way to accomplish one's goals, the development of adaptive self-regulation is one of the most important developmental tasks in the first years of life. On the other hand, dysfunctional self-regulation has been shown to result in increased risk of behavioral problems, poor performance at school or working place, rejection by the social environment, physical health problems or mental disorders.
Since even newborns already show first self-regulation attempts, the prenatal environment should be considered – next to postpartum environmental conditions. One factor potentially playing a critical role is pre- and postnatal maternal psychopathology including pregnancy-specific anxiety.
Although there is a general consensus on the multidimensionality of the construct 'self-regulation' and its etiology, evidence on the specific predictors and risk factors for self-regulation deficits remain to be determined. Furthermore, a simultaneous examination of pre- and postnatal factors in the development of infant self-regulation is needed and appropriate prospective longitudinal studies are scarce.
METHODS
The present study explored the effects of maternal pre- and postnatal symptoms of depression, general anxiety and pregnancy-specific anxiety on the infant's self-regulation development in a prospective longitudinal design based on data from N=225 mother-infant dyads. Pregnant mothers were recruited at University Obstetrics and Gynaecological Hospital Heidelberg from the 20th week of gestation on. Exclusion criteria were fetal genetic disorders or malformations or multiple pregnancy. Maternal symptoms of depression, anxiety, and pregnancy-specific anxiety were tested with online questionnaires (EPDS, STAI, PRAQ) applied at 5 prenatal and 3 postnatal assessments. Infant's self-regulation (crying, feeding, sleeping) was tested at the age of 3 and 6 months postpartum, using the crying-feeding-sleeping questionnaire (SFS).
RESULTS
Pregnancy-specific anxiety turned out to be the most significant predictor for infant self-regulatory

problems. At infants' age of 3 months, all regulatory problems (crying-/sleeping ($p<.001$), feeding problems ($p<.05$)) were significantly predicted by maternal pregnancy-specific anxiety which also explained 13,3% of the variance in infant feeding problems. At the age of 6 months, infant feeding problems were also predicted by pregnancy-specific anxiety ($p>.05$).
Even when controlling for postnatal maternal psychopathological symptoms, pregnancy-specific anxiety remained a significant predictor for infant crying/sleeping ($p<.05$) and feeding problems ($p<.001$) at the age of 3 months. At the age of 6 months, only crying/sleeping problems were predicted by maternal pregnancy-specific anxiety whereas feeding problems were predicted by postpartum maternal symptoms of depression.
CONCLUSION
Our results suggest that the prenatal environment already plays a substantial role in infant self-regulation development during the first months of life. Pregnancy-specific anxiety seems to particularly impact infant self-regulation which underlines the importance of clearly tailored early prevention and intervention for young mothers/families during pregnancy and postpartum.

## PC-052 The classic Model Room task: A symbol that doesn't measure symbolism

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Using a model room as a symbol of another room has been claimed to require understanding of representation. In principle however it only requires understanding of spatial correspondence. Here pre-schoolers' (N = 175) performance on the Model Room Task (DeLoache, 1987) is found to be associated with their understanding of pure spatial correspondence ($rp = .36^{**}$) but not their understanding of mental representation as measured by the False Belief task ($rp = .06$). The Model Room task is a purely spatial task and does not measure understanding of representation.



## PC-053 CUPs - Children's Understanding of Possibility: 3-year-olds' problems with cups tasks are not sensitive to probability ratio

Michael Huemer
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CUPs - Children's Understanding of Possibility: 3-year-olds' problems with cups tasks are not sensitive to probability ratio Michael Huemera, Brian P. Leahya, Matt Steelea, Jan M. Engelmannb, & Susan Careya a Harvard University, Cambridge MA, USA; b University of California, Berkeley, USA Young children don't always consider alternative possibilities when planning. Suppose a prize is hidden in a single occluded cup and another prize is hidden in an occluded pair (see Figure 1, left panel). If given a chance to choose one cup and receive its contents, choosing the singleton maxi-

mizes expected reward, because each member of the pair might be empty. Yet 3-year-olds choose a member of the pair almost half the time. (e.g., Mody & Carey, 2016). They are not guessing at random (chance is .33), yet they are far from maxim-izing expected reward.

One proposal to explain these findings is that most 3-year-olds deploy minimal rep-resentations of possibility (Leahy & Carey, 2020). They infer the location of the prize in the singleton, as there is only one place for it to be. They simulate the other prize going into one member of the pair. But instead of bearing in mind that that outcome is merely possible, they take the simulated location to be the fact of the matter. Thus, they have a belief about each prize's location: one prize in the singleton, and another prize in the simulated member of the pair. Children deploy no possibility concepts – that is, representational indicators (markers, symbols) of mere possibility – to distinguish the simulated belief from the inferred belief. The represented state is merely possible, but its mere possibility is not marked in the representation. This computational process yields 50% choice of the singleton: since chil-dren have a belief about each prize's location, they choose at random between those two locations.

When chimpanzees are presented with the 3-cups task, they take the singleton cup about as often as 3-year-olds. However, when chimpanzees are presented with versions of this task in which they have a choice between a singleton cup and a cup from a set of three or more cups, they take the singleton cup much more often. This increases with the number of cups on the set side, e.g., in the 7-cups ver-sion (see Figure 1, right panel) they take the singleton cup in 84% of the trials (Hanus & Call, 2014). Increasing the number of cups on the set side makes it less likely that a particular cup contains a prize. This might help children to recognize them as merely possibly containing a prize, and, subsequently, to choose the singleton more often. We tested 22 3-year-olds with four test trials each on the 7-cups and the 3-cups task. Overall, the singleton cup was se-lected in the 7-cups task on 58% and in the 3-cups task on 56% of the trials. The data pre-sented here support the hypothesis that 3-year-olds do not bring possibility concepts to bear on both the 7-cups and 3-cups task. Instead, they support the view that 3-year-olds draw on minimal representations of possibilities.

## PC-054 What children from majority and minority groups want to know about in- and out- groups, and how knowledge affects their intergroup attitudes

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Research suggests that adults, and possibly children, construe in- and out-groups differently. Namely, whereas the former is viewed as a heterogeneous set of unique individuals, the latter is construed as a homogeneous category. The present studies investigated whether there might be differences between Israeli children from majority (Jewish) and minority (Arab) groups in this regard. In Study 1, 64 Jewish and 64 Arab kindergarteners and 2nd graders saw a picture of an outgroup member, and were asked whether they want to know information about the individual or his/her category. We found that whereas Arab children from both age groups asked for more category information regarding

out- than in-groups, only Jewish 2nd graders did so. In Study 2, we first assessed 96 Jewish and 194 Arab kindergarteners and 2nd graders' attitudes towards the two groups, then provided them either with individual or category information about category exemplars, and finally re-assessed their attitudes. We found that among both Jews and Arabs, across ages, provision of information about out-group individuals led to more positive attitudes toward the out-group. Moreover, providing Arab kindergarteners category information led to fewer positive attitudes toward the out-group. These studies reveal nuanced differences in majority and minority children's construal of in- and out-groups, and the consequent varying effects of construal information on their attitudes.

## PC-055 A developmental investigation of conceptions of national identity in Turkey

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"How national identity is conceptualized (e.g., in ethnic vs. civic terms) is related to inter-group attitudes (Pehrson et al., 2009; Verkuyken & Martinovic, 2015). This study aims to investigate the development of national identity conceptions and their relationship with assimilation expectations among majority and minority children in Turkey.

Sixty-two Turkish majority children were tested: 35 6-7-year-olds (Mage = 7.11, 21 girls) and 27 9-10-year-olds (Mage = 9.91, 17 girls). On each of the 24 trials, participants saw a character with two contrasting features, each of which associated with a made-up nationality (Aka vs. Mim) that would reflect one of four dimensions of national identity (ethnic, civic, cultural, and affective). For instance, participants would see a character whose parents are from Aka (ethnic), but who lives in Mim (civic), and decide which national group the character would belong to. Next, participants were presented with an immigration scenario and asked if they think the targets' identity-related features would change after immigration.

Children prioritized ethnic dimension over others (ps < .001) and civic dimension over cultural and affective dimensions (ps < .001), yet they did not differentiate between cultural and affective components (p = .4). Older children prioritized ethnic over civic dimension more than younger children (p < .01). Children's expectations of assimilation after immigration increased along with SES (p < .05) and tended to be higher for children who prioritize civic over ethnic dimension (p = .07). Next, we plan to collect data from minority groups in Turkey."

## PC-057 Explaining the Development of Mirror Self-Recognition in Infancy

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Recent cross-cultural work showed that the 18-month shift we observe in Western urban infants' mirror self-recognition (MSR) abilities is not universal (e.g., Keller et al., 2004). The differences in self-developmental trajectories are functionally explained by cultural emphasis on psychological autonomy in socialization. But, less is known about the proximal developmental processes. In this presentation, we will focus on the ontogeny of objective self-awareness and ask the question: "Which specific social experiences may be contributing to the construction of self-representations in toddlers?". We will present results from a study where we examined the mother-toddler interactions during free play in a mixed sample of ni-Vanuatu and Canadian toddlers (Cebioglu & Broesch, 2021). In this study, parents' imitation of toddlers' bodily actions was the only significant predictor of toddlers' MSR performance. We argue that bodily imitation creates a joint attention context that helps children see themselves from the third person perspective and integrate kinesthetic and visual schemas involving the self. In addition, in an ongoing study, we compared the referential content of caregivers' child-directed speech to their 21-month-old toddlers in Canada and Vanuatu and observed more references to children's internal states and tangible body parts in Canada. We argue that parents' references to their to toddlers renders the toddler the object of the dyad's joint attention and shapes toddlers' opportunities to attend themselves. Based on these two studies and in light of existing developmental literature, we will discuss the potential roles of joint attention to self in the development of self-representations in toddlerhood.

## PC-058 Assessing intellectual humility across childhood

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We investigate 4- to 8-year-old children's (n = 100) propensity and competence to display Intellectual Humility (IH), defined as the ability to recognize and act on the fallibility and limits of one's knowledge. As we do not know much about how IH develops across the lifespan, it is difficult to develop successful interventions to promote it. We will present results from an experimental battery that captures distinct components of IH. The sensitivity block captures children's propensity to observe the world and their competence in detecting errors in the information provided. We analyze children's behavior in a visual search task, examining how they detect inaccuracies in the given information. The awareness block captures children's propensity to track their certainty given the information given. We measure whether children's confidence judgments reflect the task's uncertainty and ex-

amine the explanations children provide to support their confidence judgments. The action block captures children's propensity to actively seek out additional information when needed, as well as their competence in making informative queries. We measure how much and how efficiently children ask questions and search for information across different scenarios. The revision block captures children's propensity and efficiency in revising their initial beliefs depending on the relevance of the new evidence provided. The appreciation block investigates children's sensitivity and preference for intellectually-humble versus arrogant agents. Data collection is still ongoing, and will be completed by the end of September 2022.

## PC-059 The developmental origins of intellectual humility

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Human knowledge is complex and often acquired through cooperative exchanges with others. The construction of the Large Hadron Collider in CERN for example required the effort of more than 10.000 scientists and technicians from different countries all around the world. Such endeavors indicate on the one hand that each individual has a potential contribution to make, while on the other hand being confronted with the very limitations of their own perspective. How does this awareness of epistemic limitations as well as potential contributions develop? In this talk I will first present a theoretical framework of the epistemic virtue of intellectual humility according to which it can be defined as the tendency to neither overrate nor underrate epistemic limitations or contributions of oneself and others. For example, when confronted with peer disagreement, one should neither overrate oneself and stand fast nor overrate the other and follow their opinion but instead seek additional information to resolve the conflict. On this basis I will second introduce two studies (N = 154) that investigate children's (3- and 5-year-olds') reactions to peer disagreements over facts. Both studies show that preschoolers seek more information when confronted with disagreement in contrast to agreement by an epistemic peer. Implications for the developmental origins of intellectual humility are discussed on this basis.

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# ONLINE PRESENTATIONS

## OP-01 Young children's attitudes toward robots and other outgroups

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Understanding how young children see robots is crucial practically because robots are becoming increasingly abundant in children's lives and theoretically because robots let us ask the curious question of how children perceive machines that look like living beings. This study evaluates young children's attitudes toward robots using the intergroup contact theory – the idea that a brief positive interaction with a member of another social group, i.e., outgroup, improves attitudes toward other members of the outgroup (Allport, 1954). Further, contacting one outgroup often causes the secondary transfer effect in which the positive attitudes generalize toward other outgroups (Pettigrew, 2009). Recent research suggests that adults improve their attitudes toward robots after a brief interaction with one robot (e.g., Akay et al., 2022). However, not much is known about developmental changes in such attitudes.

The present study examined how a brief positive interaction with a humanoid robot (NAO) affected children's attitudes toward robots and other outgroups. Comparing the interaction condition to the no-interaction condition, we tested 69 Caucasian 4- to 6-year-olds (Mage = 5.65) on their attitudes toward robots and ingroup peers (the intergroup attitude task); and 43 4- to 6-year-olds (Mage = 5.99) on their resource allocation to a robot, ingroup child (Caucasian and of the same gender as the participant), and 8 outgroup members (see Fig. 2; the resource allocation task). In the intergroup attitude task, children decided whether their ingroup peer and robot have 4 positive (e.g., nice) and 4 negative traits (e.g., ugly). Children showed positive attitudes toward robots in both conditions; however, children in the interaction condition favored the outgroup robot over their ingroup peer more than did children in the no-interaction condition ($U = 317$, $p < .001$) (Fig. 1). In the resource allocation task, compared to children in the no-interaction condition, children in the interaction condition allocated significantly fewer play coins to some outgroups including an East Asian child ($U = 121.5$, $p = .007$), wheelchaired child ($U = 132.5$, $p = .016$), Black child ($U = 101.5$, $p = .002$), and elderly ($U = 64.5$, $p < .001$) (Fig. 2).

This finding in the resource allocation task may seem counterintuitive as the secondary transfer is about positive attitudes to one outgroup generalizing to different outgroups. We speculate that children perceived robots as part of a highly competent and warm group, and the status comparison between this high competence and/or warmth outgroup and other outgroups that might be perceived as less competent and/or warm (e.g., elderly person) might explain the observed pattern. The absence of initial prejudice and outgroup favoritism in both tasks suggests that children perceive humanoid robots as an admired outgroup. Thus, most children may hold positive attitudes toward robots, and the intergroup contact theory may not be applicable until children grow older and understand possible ways in which robots negatively affect human society. The current study asks for further research investigating developmental changes in the social status of humanoid robots in the eyes of young children.

## OP-02 Parents' and non-parents' mental state language preferences towards children as a function of child gender

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Mental state language (MSL) is a general term that refers to mental states, including cognitions, emotions, and desires. Additionally, elaborated MSL language defines instances where a mental state is clearly mentioned and then elaborated on to clarify or explain its meaning; this is contrasted to simple MSL, where mental states are simply labelled (Slaughter et al., 2007). The MSL input of adults towards children is of critical import as it allows children first to represent and later participate in social contexts. Further, MSL may enable children to understand how contextual information and behaviours are linked to the mental states of others, subsequently allowing children to infer mental states and predict behaviour in social contexts (Scott et al., 2017).

The influence of MSL input upon children's development of a theory of mind (ToM), which refers to their understanding of mental states, has been well established (Slaughter et al., 2015). Further, children's ToM ability has been linked to successful and positive social interactions and relationships (Slaughter et al., 2015). Additionally, the frequency of parents' elaborated MSL input has been found to strongly predict a child's understanding of how mental states influence human behaviour, that is, their ToM ability (Ruffman et al., 2002).

A child's gender has a broad influence on parenting practices. Sociocultural and ecological constructs suggest that these parenting practices likely reflect gender roles and gender stereotypes evident throughout our society. Therefore, aiding in the socialisation of gender throughout development (Leaper et al., 1998). The language used by parents is one practice that provides a key source of information about social contexts children may represent or experience. Previous research has demonstrated that, generally, parents use language differently toward children based on the child's gender (e.g., Leaper et al., 1998). However, findings regarding the associations between MSL and elaborated MSL and a child's gender vary and are inconsistent (e.g., Jessee et al., 2016; Olson & Mamsur, 2019). This submission reports the results of two studies in which non-parent adults (Study 1) and parents of children between the ages of 3- and 6-years-old (Study 2) completed the Mental State Input Inventory, which captured their language preferences within common social situations toward male/masculine, female/feminine, and gender non-conforming child protagonists. The unique use of experimentally manipulated protagonists allowed for rigorous control over the gender identity and expression of those children across the conditions.

Findings were remarkably consistent across both studies, with non-parent and parent participants preferencing significantly less MSL towards a male/masculine (compared to a female/feminine or gender non-conforming) child protagonist. Importantly, both non-parents and parents preferenced significantly less elaborated MSL towards a gender non-conforming (compared to a female/feminine or male/masculine) child protagonist. Collectively, these findings illustrate that a child's gender identity may influence the MSL and elaborated MSL they receive from both male and female adults, regardless

of their parental status. Further, they emphasise the significance of diversifying samples and stimuli beyond binaries to expand our understanding of MSL preferences within a developmental context.

## OP-03 When remembering less gets you more: 3-year-old's use of reasoning by exclusion to infer unknown identities in working memory

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We are immersed in an information-rich environment, but have limited capacity to hold information in working memory. To cope with these limitations, one strategy is to remember partial information, and to then infer unknown or unremembered information by eliminating known or remembered alternatives. When do children demonstrate the ability to use reasoning by exclusion strategy to fill in missing information in working memory?

To answer this question, we tested 3-year-olds, who have previously been shown to use a reasoning by exclusion to find the location of an object (e.g. Mody & Carey, 2016) and whose working memory capacities are extremely limited (e.g. Simmering, 2012). Thirty-four 3-year-olds (planned sample N=48, Mean=3.63, range:3.13-4.08, 15 girls) participated in a working memory task remotely via Zoom. Children completed two blocks. In the Face-up block, two or three virtual cards with pictures of different animal characters on their faces were shown face up, and were then occluded. The experimenter then randomly probed one of the cards and asked children to choose the probed object's identity from two alternatives. The Exclusion block was identical to the Face-up block except that all but one card was shown face up before being occluded (that is, the face-down card's identity was unknown). Children were then asked to choose from two alternatives the identity either of the card that was previously face-up (Target-up trials), which required children to retrieve stored information from working memory, or the card that was previously face-down (Target-down trials), which required children to use reasoning by exclusion to eliminate the remembered options and choose the previously unobserved identity from two alternatives.

Data collection is ongoing, but preliminary results showed that in the Face-up block children selected the correct target at rates significantly above chance in 2-card trials ($M=65\%$, $t(33)=4.38$, $p<.001$), but not 3-card trials ($M=58\%$, $t(33)=1.57$, $p=.13$), consistent with previous work showing limited working memory capacity in 3-year-olds (Simmering, 2012). By contrast, in the Exclusion block, children were above chance in both 2-cards trials ($M=69\%$, $t(33)=4.21$, $p<.001$) and 3-cards trials ($M=65\%$, $t(33)=3.85$, $p=.001$) in both Target-up ($M=69\%$, $t(33)=4.67$, $p<.001$) and Target-down trials ($M=64\%$, $t(33)=2.69$, $p=.011$).

These results suggest that 3-year-olds were able to use reasoning by exclusion to infer the unknown identity by ruling out remembered alternatives, and could do so even under high memory loads. Furthermore, our results suggest that remembering less information at the outset helped children to achieve better memory performance overall; children achieved better working memory performance when they relied on reasoning by exclusion to infer to the identity of one of the objects (in

the Exclusion block) rather than remembering the identity outright (in the Face-up block). Together, our results suggest that the foundations of efficient working memory use via exclusive reasoning may be laid early in development.

## OP-04 Clarifying the Causal Logic of Classic Control of Variables

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Self-directed learners are often described as 'intuitive scientists', yet they tend to struggle in assessments of scientific reasoning. We investigate a novel explanation for this apparent gap; specifically whether classic difficulty with the control of variables strategy (CVS) stems from a mismatch between task presentation and learners' causal intuitions. Children (7- and 9-year-olds) and adults were tested on a traditional CVS task (Tschirgi, 1980; Croker & Buchanan, 2011) in which three variables combine to produce an outcome. Participants must select a test of the hypothesis that one variable caused the outcome, and the other two are non-causal. However, the options presented in the traditional design do not offer a coherent assessment of experimentation. First, the to-be-tested hypothesis claims that the outcome is causally dependent on one variable, but also that it is independent of the other two. However, applying CVS to this independence claim (e.g., holding the suspected cause constant while changing the other two) is considered an uninformative, incorrect response. Second, for either test to be informative, participants must assume that none of the novel variables employed are causally efficacious, which is contrary to conducting controlled experiments in the real world. We modified the task to clarify these ambiguities and found that, in all age groups, a significant majority of participants selected informative experiments and avoided confounded actions. These results contrast the longstanding claim that learners are unable to correctly employ CVS without extensive training and suggest self-directed scientific inquiry may be intuitively suited to supporting causal learning."

## OP-05 Disentangling the factors that influence polarity in infant MMR – A critical review

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The mismatch response (MMR) in EEG recordings is a powerful measure to assess perceptual discrimination, especially in developmental populations, as it does not require overt attention. In infants, the MMR can have both a positive polarity (pMMR) and a negative polarity (nMMR). Age has been proposed as the main factor driving this difference, as the pMMR found in younger infants changes towards an adult-like nMMR with increasing age. However, there is growing evidence that age influences the MMR polarity in interaction with other factors, such as discrimination difficulty. In the current review, we systematically assessed which factors influence the polarity of the MMR. We included studies investigating the discrimination of simple tones, phonemes, syllables, or tone contrasts in 0- to 24-month-old typically developing monolingual infants. We found the following factors to influence MMR polarity: (1) Age; (2) Sleep state: quiet or active sleep or being awake; (3) Salience of the contrast; (4) Nativeness of the contrast; (5) Duration of inter-stimulus interval; (6) Data preprocessing methods; (7) Analysis time window; (8) Experimental design: subtracting physically identical or different stimuli. Our data suggest that although there is evidence for an age effect, this effect can only be interpreted in a meaningful way in its interaction with other factors. This is crucial, as opposite polarities cancel each other out, potentially resulting in unjustified null-findings. We expect our review to inform decisions on study design and MMR data interpretation in the widespread application of the MMR in developmental studies.

## OP-06 Values and valuable narratives: Relationships between children's exposure to narratives and their moral orientation

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Empirical evidence suggests that exposure to narratives may affect moral development (Johnson, 1990), stimulate empathic ability and prosocial behaviour (Koopman, 2015) and affect moral behaviour (Lee et al., 2014). It is not currently known, however, how the type of narrative affects the relationship between narrative fiction and moral orientation, although it seems likely that different types

of narrative have differential effects in terms of the norms and values they are likely to stimulate. In order to gain a more complete picture of this relationship, the current study makes a distinction between hedonic and eudaimonic narratives. The former are primarily aimed at enticing entertainment emotions and thus are expected to stimulate a pleasure-based moral orientation. Eudaimonic narratives, in contrast, are contemplation-inducing and are associated with truth-seeking motivations. As such, they may stimulate moral orientations that reflect a desire for a deeper sense of meaning (Oliver & Raney 2011).

The current study investigated whether 8-16 year-old children's moral orientation is congruent with their exposure to hedonic and eudaimonic narrative fiction. Eudaimonic narrative fiction exposure was assumed to be associated with the endorsement of eudaimonic moral values (such as considering others' wellbeing to be of primary importance), whereas hedonic narrative fiction exposure was thought to be associated with a greater orientation towards hedonic moral values (e.g., focusing on having fun in life). We investigated these predictions by providing 91 Dutch children with a questionnaire that assessed their hedonic and eudaimonic reading experiences. Furthermore, moral orientations were assessed using the Picture-Based Value Survey (PBVS, Döring et al., 2010) for the 8-11 year olds (which asks participants to rank various moral dimensions in terms of importance) and the Portrait Values Questionnaire (PVQ, Schwarz et al., 2001) for the 12-16 year olds (assessing to what extent participants endorse particular moral values). The eudaimonic values Universalism ('understanding, appreciation, tolerance and protection for the welfare of all people and for nature') and Benevolence ('preservation and enhancement of the welfare of people with whom one is in frequent personal contact') and the hedonic values Hedonism ('pleasure and sensuous gratification for oneself') and Stimulation ('excitement, novelty, and challenge in life') were considered the most relevant values to investigate in the current study.

The results reveal that there are no associations between the type of fiction and moral orientations for the younger age group. However, the older age group showed clear positive correlations between exposure to eudaimonic narratives and the eudaimonic values Universalism and Benevolence. For the hedonic narratives, the findings were more mixed: there was a positive correlation with hedonic book exposure and Stimulation, but no correlation with Hedonism (see Tables below). These outcomes thus suggest that for younger children narrative choices do not seem to shape moral orientation, but that older children may be influenced by the kind of fiction they are exposed to. This research demonstrates that it is relevant to assess the type of narratives that children are exposed to in understanding how narratives can be used in stimulating the development of specific moral orientations.

## OP-07 Early Numeracy and Home Learning Environments of Preschool Children in Argentina

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Interest in early numeracy has increased in recent years, as a link between early number skills and later mathematical achievement has been established. These skills are in turn related to home practices in which children exchange numerical information with their caregivers (Home Numeracy Environment, HNE). Our aim in this study was to describe the HNE of 169 Argentine children aged 3 to 5 years in terms of: (1) the frequency and type of number activities shared with adults at home in the past week; and (2) mothers' beliefs about early mathematics. Specifically, we examined the relationships among age (3 n = 80, M = 41 months; 4 n = 51, M = 53 months; 5 n = 38, M = 67 months), gender (85 girls, 84 boys), SES, number activities, and maternal beliefs. SES groups (high n = 98; low n = 71) were determined using a Quality of Life Index, correlated with maternal education. Participants were contacted through social media and preschools, and asked to complete an adaptation of the Early Math Questionnaire (Missall et al., 2015). The first section collected demographic data. The second section included 17 numeracy activities that were to be rated individually according to how often they occurred on a 5-point Likert scale (from "never" to "more than once a day"). These activities were later rated as low (e.g., counting, estimating quantities) or high difficulty (e.g., comparisons, interpreting and producing written numbers). Finally, mothers were asked to rate their agreement with 9 math-related statements on a 4-point scale (from "strongly disagree" to "strongly agree"). Results show a positive correlation between age and shared activities of both high [rho(167) = .361, p<.001] and low difficulty [rho(167) = .163, p=.024], although the effect seems to be greater for high difficulty activities, especially those involving written numbers. Maternal beliefs, on the other hand, were unrelated to age. SES correlated positively, although modestly, with shared activities. High SES mothers were more likely than low SES mothers to report sharing low difficulty activities [rho(167) = .164, p=.033], such as reciting number words. However, this relationship was not present for high difficulty activities. Also, no relationship was found between SES and maternal beliefs. Finally, the child's gender did not influence shared activities, but it did correlate with maternal beliefs. Mothers of girls were more likely than mothers of boys to report that they preferred teaching their child oral language over mathematics [x2(3) = 8.857, p=.031]. Accordingly, mothers of boys showed stronger agreement with the statements "children can learn math before they enter preschool" [x2(3) = 8.32, p=.040] and "it is my job to teach my child math at home" [x2(3) = 8.311, p=.040].

Although limited, this study represents a first approach to describe the HNE of Argentine preschool children. Exploring home education practices in early childhood is crucial to identify potential strengths and difficulties, providing a starting point for situated interventions that align the learning trajectories of children from different SES backgrounds.

## OP-08 Memory and me: Exploring bidirectional links between self and memory across early to late childhood

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Objectives: Our research objective was to explore the co-development of self-knowledge and autobiographical memory across early to late childhood. Based on extant research, we hypothesised that children's self-knowledge would increase in volume and complexity across 3 to 11 years. Across the same period, we expected to see increases in the specificity of autobiographical memory reports, and in children's ability to recall their own role in recent events. Our key aim was to test whether these developments were bidirectionally related, as predicted by a theory known as the self-memory system.
Methods: We gathered self-descriptions and autobiographical memory reports for important life events (first day of school/nursery, last birthday) from 379 3- to 11-year-old children, M=90.33, SD=31.10. We also had children take turns with the researcher to perform simple actions. After a short distracter task, we tested children's recall for these actions, and who they were performed by.
Results: The volume and complexity of self-knowledge, and the volume and specificity of autobiographical memory reports increased with age. Children's ability to recall actions and who they were performed by increased with age, alongside a bias for recall of their own actions. Regression analyses and structural equation modelling confirmed significant bidirectional relations between these developments.
Conclusions: These results confirm that development growth in self-knowledge across childhood predicts growth in autobiographical knowledge and self-processing capacity, and vice versa. This finding is relevant to our understanding of the protracted development of the self-memory system across childhood, which may contribute to the gradual offset of childhood amnesia.

## OP-09 Mirror Self-Recognition in ni-Vanuatu Toddlers

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The Mirror Self-Recognition (MSR) test is the most commonly used assessment for capturing the onset of objective self-awareness in infancy, i.e., the ability to think about oneself. The behavioral criteria for passing the test is removing a mark placed surreptitiously on one's face, which children from Western urban samples start doing at around 18 months, and most do by 24 months (Lewis & Brooks-Gunn, 1979). Before children pass the MSR test, the following developmental pattern is observed: between 6 and 12 months, joyful mirror-directed behaviors occur, usually interpreted as social responses; testing the visual-kinesthetic synchronicity prevails around 12 months, and wariness and self-conscious emotional reactions are shown from around 14 months (Amsterdam,

1972). The developmental trajectory of reactions to the mirror has not been studied in non-Western populations. A limited number of cross-cultural studies show that MSR passing rates in non-Western rural communities are significantly lower in the 18 - 24 month age window (e.g., Keller et al., 2004; Kärtner et al., 2012). Because no older children were tested in these studies, the typical age of MSR onset in non-Western cultures remains unknown. In addition, the prevalence of children's behavioral inhibition during the MSR test in some communities raises concerns regarding the validity of using mark-directed behavior as a universal index of objective self-awareness (Broesch et al., 2011). The current study was conducted in rural Vanuatu, a small-scale island society located in the South Pacific, with a focus on investigating children's (N=56; age range: 17-36 months) developing self-awareness in the context of the mirror situation. To go beyond the pass/fail measure of the MSR test and understand children's development in greater detail, we present the results of the coding scheme created to capture their behavioral and emotional responses to the mirror before and after being marked on the face. We explore age-related changes in children's responses and discuss similarities and differences between behaviors observed in our sample and ones previously described in Western literature. We report on behavior not recorded in existing behavioral checklists - visually checking for correspondence between the mirror and the surrounding - and discuss it regarding ni-Vanuatu children's understanding of the mirror's reflective properties. In addition, we examine the validity of using mark-directed behavior as a sign of objective self-awareness in this environment. Our results support the validity of the MSR test by showing that mark-directed behavior is correlated with another self-aware response, i.e., embarrassment.

## OP-10 A cross-cultural study of Maternal Attribution of Agency (MAA)

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Very early on, infants have goals, aboutness, and propositional attitudes that can be interpreted by an adult (Carey, 2009). This is part of the interactional engineering where caregivers play a crucial role in early socialization. Since little is known about the capacity of maternal attribution of agency in non-Western populations, we ask how this capacity takes place in situated interactions, and we wonder if agency as a constitutive capacity has different characteristics and structures across cultures. Most of the research on mother-infant interactions is primarly experimental and has been conducted in Western populations. We examine naturally-occurring mothers' attribution of agency (MAA) among the Wichi (Indigenous population living in the Chaco forest of Argentina) and Spanish-speaking families of European descent living in Argentina. Sixteen indigenous Wichi families and Spanish-speaking families of European descent participated in this study. We focused on naturalistic interactions, conducted at home, involving caregivers and their infants ranging from 12 to 30 months. Study 1 focuses on creating an original coding system generalizable enough to observe maternal attribution of agency in both cultural groups. Using the constant comparison method (Strauss & Corbin,

1990), we interactively analyzed caregiver and infant language and actions, looking for indicators of caregiver interpretation of goal-directed behavior and propositional attitudes. First, we coded whether an interaction was a MAA and whether that MAA was verbal, corporeal, or multimodal. Within the verbal categories, we coded the discursive strategy used by the caregiver in the MAA as to whether it was conversational, prescriptive, or referential (Taverna, 2021). We then observed who attributed the goal-directed or propositional stance and who performed the behavior aimed at facilitating or obstructing the infants' desires or goals (mother, another adult, or a child). In Study 2, the categories that emerged from this method are now being analyzed quantitatively. Preliminary comprehensive analyses of videotaped naturalistic home interactions have shown that while there are no significant differences in the amount of time caregivers attribute agency, communicative semiosis varies: (a) Wichi caregivers tend to use corporeal communication in the MAA ( pick the child in hand when about to touch a dangerous object) than their Spanish-speaking counterparts, who tend to use verbal communicative semiosis. Second, Spanish-speaking caregivers tend to maintain interactions within the dyad, whereas the Wichi population expands from this dyad presenting multiparty participation (de Leon, 2011). Third, discursive strategies differ in the verbal attribution of agency: Spanish-speaking mothers frequently use mental speech ("Do you want food?"), whereas Wichi mothers resort to other discursive strategies such as directives ("Eat"). These observations suggest that maternal attribution of agency is culturally organized and has different structures and characteristics in these two different cultural groups.

## OP-11 Argumentation from evidence: Young children use disconfirming evidence to falsify causal claims

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Evidence-based argumentation (EBA) constitutes a significant part of scientific activities and it is suggested that it should have a key role in science education. Recent research suggests that young children have emerging abilities to engage in nascent forms of EBA. As a part of a longitudinal study, we investigated the development of EBA in a sample of 204 children when they were 4- and 5.5-years-old (t1 and t2, respectively). We used an adaptation of the blicket detector paradigm. At each time point, children first learned the cause of a light effect. Later, a puppet who was ignorant of the causal relations presented a false causal claim. We examined children's verbal counterarguments and their ability to identify disconfirming evidence that refutes the puppet's claim. More children disagreed with the puppet and provided a valid verbal counterargument in t2 (69%) than in t1 (53%). While around 40% provided evidence-based disconfirming arguments at both times, there was a significant increase from t1 (22%) to t2 (49%) in the arguments that explained the actual cause of the light. The majority of children (80%) correctly identified causal disconfirming evidence at both times, and 5-year-olds (63%) could also identify noncausal disconfirming evidence. Thus, even 4-year-olds understand that evidence is a means to argue against claims. Older children refer to actual causal

mechanisms more than younger children and they are better at reasoning about noncausal evidence. We will discuss further the relations between the development of the theory of mind and EBA."

## OP-12 Relevance as a supermaxim? – An experimental pragmatic investigation of a basic tenet in language philosophy

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The cognitivist view of communication states that conversation is based on a cooperation of participants, interpreting the situation on the basis of a plan they partly share. In order to understand the communicative intention of the speaker, we must find a meaningful connection between their behavioral responses and their utterance.

Background

In harmony with the cognitivist stance above, Grice (1957, 1975) established the notion of the Cooperative Principle and identified its four maxims (Maxim of Quality, Quantity, Manner and Relevance (Noveck-Sperber 2004). Sperber and Wilson (1986) claims that Relevance acts as a super-maxim as the other three maxims can be integrated into it, as all three boil down to sticking to the universal cognitive principle of relevance. We test if our experimental results back up the idea that Relevance integrates all other maxims.

Method

We measure preschoolers' first- and second order mentalization skills with a False Belief Test (Baron-Cohen 1985, 1995), and compare participants' ability to recognize the infringement of the Gricean maxims in view of their social cognitive skills. Relevance Maxim results are tested if they can be seen as integrating other maxims.

Findings

The development and the smooth coordination of discourse significantly improved with FBT level mentalizing competence. The Maxim of Relevance proved to be the first one to be followed, thus it seems to bring along further refinement of maxim infringement recognition.

Conclusions

Preschoolers demonstrate an awareness of all maxims but the unfolding of the fully-fledged ability to follow them reveals a developmental trajectory. Our experimental findings support the claim that relevance is a super-maxim and integrates the other three maxims.

## OP-13 Can encouragement from communication robot enhance children's persistence?

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Persistence, which is the tendency to pursue long-term challenging goals, is a key factor of positive outcome years later (Lucca & Sommerville, 2018). Persistence at early childhood is heavily influenced by social environments such as caregivers (Mokrova et al., 2012; Shinya & Ishibashi, 2022). For example, children whose parents praised process of the children' efforts and their hard work, were more persistence than those whose parents praised less often (Lucca et al., 2019). However, whether children' persistence are enhanced from others has yet to be sufficiently examined. In the context of human-robot interaction, it has been reported that communication robot named "CommU"(Vstone Co., Ltd.) helped to facilitate joint attention in children with ASD (Kumazaki et al., 2018) and women are likely to prefer to self-disclose CommU than human (Uchida et al., 2020). CommU is a visually simple robot compared to humanoid robot which does not provide strong social pressure as an agent (Uchida et al., 2020). Considering this, it is also expected that CommU positively influence to interact with parent-child relationship and help to buffer parents' stress at home (Itakura, 2022). Given that these evidence, it might be possible that children's persistence may be enhanced by CommU as similar with their parents. Here in this study, we examined how the encouragement of CommU influence to children' persistence during their task engagement. More specifically, we examined whether children's persistence is affected by under conditions with and without praise from CommU. In a within-subject design, 22 18- to 24-month-old children (11 females, Mage = 21, SDage = 2.2, range = 18.00-24.00) were assigned either praise condition (e.g., CommU praised the children' attempts such as "you're doing hard work!") or no-praise condition. The order of conditions was randomized within participants. We used a toy which consisted of a rod with a base and stacking gears (Lucca et al., 2019). Children were required to insert the gears into the base, but it was impossible to insert them. We counted/measured the number of the children' attempts during the 2-minute task. In addition, the number of children' asking help from mother or assistant was measured. The results showed that the duration of the children's attempt was 21.78 s (SD = 18.22) in the praise condition, whereas 15.36 s (SD = 16.02) in the no-praise condition. Also, the duration of the children's asking help was 6.85 s (SD = 9.19) in the praise condition, whereas 8.47 s (SD = 8.93) in the no-praise condition. These results indicated that the children may be more likely to persist and less likely to ask for help when the CommU gave the praise. Our results provide the new evidence that encouragement from CommU help to motive children's task engagement as well as their parents.

## OP-14 From Fetal and Newborn Kinematics to Neuro-developmental Risk: Bayesian approaches to identifying developmentally-salient motor activity in 1-month old infants

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Birth is the single most dramatic change in environment in the lifetime of the human brain, triggering a rapid period of reorganization in neuronal function and motor activity. Building upon fetal exploration of their own bodies and the womb milieu, infants navigate their novel visual environment and exploit their maturing physical capacities. Our longitudinal Perinatal Imaging Partnership (PIP) probes continuity and change across the transition from fetal to neonatal life, breathing new life into the nature-nurture debate with Bayesian computational theories of development. We apply semi-automatic Bayesian kinematic and visual feature analysis to identify developmentally-salient aspects of prenatal and postnatal motor activity. Recordings of 20 babies spontaneous movement for 15 minutes is undertaken prenatally via ultrasound and again by videorecording newborns within the first week life, then again at 1 and 5 months of age in the lab tracked with sensors. The kinematics are utilised to track each infant's unique perinatal trajectory of motor development and associated with subsequent behavioral assessment. Leveraging existing videos of 60 1-month old newborns collected from the UK, OpenPose extracted time series data of infant kinematics to this sample and applied these models to the sample of infants with ultrasound data. Entropy and efficiency from kinematic descriptive of targeted movements are then calculated, identified via computer-vision and Naïve Gaussian Bayesian Surprise learning techniques (Chambers et al., 2020). The kinematic properties of infants differed by mode of delivery, such that infants born C-section were more similar to older infants at 1-month and less similar to their fetal ultrasound data relative to infants born transvaginally. Prior studies in children as young as 4 months have identified characteristics of infant actions indicative of severity of neurodevelopmental disorder, teratogenic exposure and precocious motor development. Few studies assessed the prototypical kinematics of motor activity in newborns, but in older children smoother kinematic trajectory of infant motor actions such as face touches are associated with greater maturity and predict later motor development. This is grounded in fetal patterns of motor activity: for example, face touches to sensitive areas of the face such as the mouth are more frequent with advancing gestational age and might be relevant for latching after. However, previous research has not treated gesture detection in as much detail as observation-based coding of actions identified as developmentally-salient, such as detecting goal-directed movement of the hands occluding mouths, nose or eyes. To explore how combinations of fetal and neonatal movement features relate to clinically-assessed risk for delayed motor development using the Mullen scale, we apply matrix decomposition to our set of apriori kinematic features. Potential clinical applications and implications for fetal body schema are discussed.

## OP-15 Social norm cognition in preverbal infants: Recognition and application of "sequence of arrival" rules by 10.5-month-olds

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Social norms refer to behavioral standards shared and enforced by a community (Chudek & Henrich 2011). Furthermore, it has been suggested that social norms such as reciprocity rules are foremost examples of interdependent collective behaviors (Bicchieri 2017).

Research on socio-moral development demonstrates that infants have at least basic ability to reason about other's mind (Scott & Baillargeon 2017, Wiesmann et al. 2020) and they recognize general moral principles such as fairness, ingroup support, harm avoidance and authority (Ting et al. 2020). However, the effects of shared behavior patterns in a group are not fully discussed, and little research has investigated whether preverbal infants recognize social norms. Therefore, we take an example of a norm violation behavior, cutting-in-line behavior, to investigate social norm cognition in preverbal infants. Specifically, our study seeks to provide evidence about the following questions: (a) Can infants recognize the social norm of "sequence of arrival" by observing the collective behaviors in a group? (b) Do they expect a newcomer agent who waits in line to be preferred over one who cuts in line?

We recruited 21 10- and 11-month-old infants to participate in our experiments. The data from 5 participants were excluded because of insufficient number of trials. We conducted a violation of expectation experiment using CG animation consisting of a norm-familiarization phase, a behavior-familiarization phase and a test phase. First, the norm-familiarization phase was presented. In this phase, there were 3 ball-shaped agents, and they appeared one by one from the right side of the screen and lined up in order. This phase is prepared to demonstrate the social norm of lining up in order. Next, in the behavior-familiarization phase, infants were habituated to two situations: one in which a new fourth agent appeared and always waited in the line behind (the WLc agent). The other is a situation where a fourth agent in different color appeared and always cut in line (the CLc agent). Lastly, in the test phase which contains four trials in an ABAB pattern, infants were presented the animation showing that the third agent approached toward either WLc agent or the CLc agent. Then, the last frame froze for approximately 20 seconds and infants' looking time toward the screen was measured. The results showed that during the first two trials of the test phase, infants' looking time was marginally longer in the test condition when a CLc agent was chosen (M=15.07s, SD=5.35s) than when the WLc agent was chosen (M=12.42s, SD=5.72s). Since more participants reached the upper limit of looking time when CLc agent was chosen, the result indicated that infants expect the agent who follows a social norm in a group to be preferred by other group members relative to the agent who violates the rule. This study provides basic evidence that infants who observed the shared behavioral pattern in a group might link it to their moral judgment. In future studies, we plan to further discuss the effect of goal understanding, moral principles as well collective behaviors.

## OP-16 What might English-learning children think why means based on their early input?

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When we don't understand the reasons for or causes behind something we can ask why and get an answer. And when we learn that we can do this – ask why and get an answer – our curiosity is nurtured. So when children the meaning of why they are learning more than just a word. But with no direct cues in the physical or linguistic context, learners must make inferences about the utterances why appears in to figure out its meaning.

For example 'why did you push that?': if the child understand that this is a question, and the meaning of 'you push that', they could figure out that the question is seeking information about a person's action. Given that the action, actor, and object are specified, these cannot be the missing information. Children ascribe intentions and motivations to people (and other agents) before they acquire why-questions (1, 2), so it is plausible they could think that the information sought is the motivation or reason for the action. By contrast, 'why does it move?' when asked about mechanical toy might lead a child to think that the question is about how the toy works (a mechanism), or what its function is (purpose). These are inferences about specific questions, but over time, the child can form a generalization that includes multiple types of reasons and causes, whilst learning that one can ask about a variety of conceptual domains.

This research examines the why-questions in the early input of 2 English-learning children (whose longitudinal data was available in PhonBank) in order to characterise possible early inferences about the meaning of why. (See Table 1 for information on the data.) All why-questions produced by the mother in files up to and including the one containing the child's first spontaneously produced why-question were examined. Each question was coded for whether it was simple or complex (why/why not? vs. why in a longer question). Complex questions were then coded for the conceptual domain being asked about, where the conceptual domains coded for lead to different possible inferences (e.g., human, artifact, natural non-living). (Simple questions do not contain clear information about domain.) We also noted the occurrence of why don't questions, as they potentially complicate learning given that they are typically requests for behaviours, not information (e.g., 'why don't you go outside and play?').

For both children, the complex why-questions in the input were predominantly about humans (typically targeting emotions/desires as motivations), and when they weren't, they involved personification (i.e., treating a non-living human as if they had human desires and emotions) (Table 2). Only one why-question that could be coded was about something other than human(like) motivations and desires. Thus, the why-questions in these two children's early experiences were quite limited, and could easily lead them to an initial understanding of why that is too narrow. This is consistent with work showing that early why-questions produced by a different sample of English-learning children were restricted to being mostly about human actions or states (3).

## OP-17 Ethnicity and Decision-Making Across the Lifespan

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People are susceptible to systematic errors in thinking, which bias their decision-making abilities. Individual and group-level differences can also impact cognition by shaping the values and motivations people hold. For instance, researchers have found relationships between ethnic/cultural identity and several facets of human decision-making, including risk tolerance and sunk-cost investments. Studies on the sunk-cost effect (i.e., continuing with an investment despite unfavourable outcomes) show that people from Western, individualistic cultures make more sunk-cost decision errors than those from Eastern, collectivistic cultures. The existing literature on risk-taking, however, presents conflicting reports. Some research suggests that Easterners display relatively higher levels of risk aversion (i.e., they are more likely to avoid losses than to seek gains due to their avoidance orientation), compared to Westerners. Other studies have found the opposite. What's more, it has been purported that the effect of cultural experience/ethnic identity on decision-making processes may be domain-dependent. For example, Easterners are only more risk averse than their Western counterparts in gain domains, but both groups share similar attitudes toward risk in loss domains. The present study aimed to clarify the association between ethnicity and risk tolerance, as well as investigate the role that ethnic/cultural differences play in investment decisions involving sunk cost. Participants (N = 482; Age Range = 3 years to 98 years) responded to two decision-making measures, our dependent variables. The Cups task assessed risk preferences through choices made in a game involving both gains and loss trials. The Sunk-Cost Fallacy task compared investment decisions between different conditions (sunk cost vs no sunk cost). Linear regressions were run for each dependent variable, while controlling for age, sex, executive functioning, and verbal intelligence. Results revealed no statistically significant difference between the decisions made by people from Western (e.g., Caucasians) and Eastern cultures (e.g., East Asians, South Asians, and Middle Easterners) on either of the measures. Bayesian analyses bolstered our faith in these null effects. These findings indicate that ethnicity was unrelated to decision-making ability across the lifespan.

## OP-18 The Effect of Cultural Globalization on the Indian Perception of the Aging Experience

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India is currently experiencing a cultural shift due to urbanization and cultural globalization. While this transition brings economic and social benefits, there are also consequences to the shift. An important population affected by this change are the elderly because they are the most vulnerable to change and the most overlooked subset of the population. Here, I compare the responses from conversations with Indian women from different generations with Indian ageing research to investigate the influence of a cultural globalization on the perceptions and experiences of ageing in India.

This preliminary analysis suggests that the fracturing of traditional family systems and a changing perspective on elder care has proved to be a very difficult transition for the current generation of elderly. An increased exposure to Western influences through social media has led to shifting life ideals, greater career-focus, and a generational divide between the younger and older generations. Consequently, the current generation of elderly may be suffering from the consequences of their inability to adapt. This manifests as increased loneliness and a greater negative self-concept. With the increasing proportion of the elderly population in India, it is vital that more research is conducted on the factors that are affecting the ageing experience to provide more suitable care for the elderly.

## OP-19 Does A Cultural Belief in Karma Predict a Cross-Cultural Variation in Reciprocal Altruism? A Theoretical Exploration

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Reciprocal altruism is a complex form of prosocial behavior first suggested by Robert Trivers in 1971. Trivers outlined the ecological and social conditions in which reciprocal altruism would be selected for as a survival adaptation in humans. This theoretical analysis examines the belief in karma as a possible cultural adaptation through which reciprocal altruism is promoted. First, this analysis explores why and how karmic belief may have evolved as a mechanism to promote reciprocal altruism. Second, this analysis proposes that we may see a cross-cultural variation in the reciprocal altruism response. Third, this article proposes a way to test whether there is a cross-cultural variation in reciprocal altruism and hypothesizes the result based on other research. Finally, this article highlights the importance of studying karmic belief as it may have cross-cultural implications on how we understand morality, motivations to engage in prosocial behavior, and more.

## OP-20 Mindfulness in childhood: Associations with emotion knowledge, inhibitory control, theory of mind and mindful parenting

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Mindfulness refers to individuals' open and non-judgmental awareness of their present mental states (Bishop et al., 2004). It has been posed as a critical skill for reducing emotional and behavioral problems in both adult and child populations, and hence, has been widely studied in clinical contexts as an important element of prevention and intervention methods (McDonald et al., 2016; Siripornpanich et al., 2018). However, mindfulness has scarcely been addressed before as a developmental skill. While children's understanding of others' mental states (theory of mind) has been studied extensively in developmental literature, children's awareness of their own mental states (mindfulness) has not been investigated from a developmental perspective. Thus, the present study aimed to fill this gap in the

literature and examined the role of socio-cognitive and environmental factors in typically developing children's mindfulness. Since mindfulness involves individuals' attention to and acceptance of their current mental states including their emotions and thoughts, we reasoned that children's knowledge of varying emotions, divergent cognitive states as well as their ability to suppress their predominant emotional responses would be needed for attending, understanding, and accepting their current status. Therefore, as socio-cognitive factors, we focused on emotion knowledge (emotion-situation knowledge and emotion recognition), theory of mind and inhibitory control. Additionally, as an environmental factor underlying mindfulness, we assessed parents' mindful parenting practices since such practices may trigger the development of relevant socio-cognitive skills in children and promote mindfulness (Duncan et al., 2009). Seventy-eight Turkish children between 8-11 years of age participated in our study. They completed emotion knowledge task consisting of emotion recognition and emotion-situation knowledge (Schultz et al., 2004), second order false-belief task (Flobbe et al., 2008), emotional Stroop task (Haas et al., 2016), and also reported their level of mindfulness on Mindful Attention Awareness Scale (Lawlor et al., 2014). Parents reported their mindful parenting practices online on Interpersonal Mindfulness in Parenting Scale (Duncan et al., 2009). Our results showed that children's emotion-situation knowledge (e.g., their understanding of which emotions would be likely to occur in given social situations) and their inhibitory control in emotional contexts were positively linked with their mindfulness. However, children's emotion recognition, theory of mind and parents' mindful parenting practices were not associated with mindfulness. Regression analyses indicated that controlling for age, both emotion-situation knowledge and inhibitory control uniquely predicted children's self-reported mindfulness. Overall, these results showed that children's accurate prediction of which emotions naturally arise in a given social context as well as their ability to regulate their predominant emotional affect positively contribute to their mindfulness in middle childhood. When children know the connection between situation and emotion, and become able to modulate their automatic emotional responses they can understand, appreciate and accept their present mental states better, which appears to be important for their emotional and behavioral adjustment. Thus, this study presented for the first time the socio-cognitive underpinnings of mindfulness in a typically developing sample of children and lay the ground for future studies to further investigate mindfulness from a developmental perspective.

## OP-21 On the question of neurobiological correlates of the cognitive basis of culture

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The cognitive basis of the opposing Western (analytical) and Eastern (holistic) culture is usually associated with such characteristics of the representatives of the corresponding culture as reliance on the functions of the left or right hemispheres or field independence/field dependence based on the results of the Embedded Figures Test (EFT). Meanwhile, the relationship between indicators of

interhemispheric asymmetry and the formation of an analytical or holistic style of an individual is far from unambiguous. Also, the cognitive functions revealed by EFT are formed late in ontogenesis and are subject to the influence of the environment, which makes their role as a key neurobiological factor in the formation of the prevailing cognitive style of cultural representatives doubtful. The study substantiates an alternative version of the main factor in the formation of the cognitive basis of an analytical or holistic culture: this is a reliance on the functions of the posterior, gnostic cortex, or the anterior cortex, which programs goal-directed behavior. These features are inherent in individuals and are realized in the formation of referential (analytical) or expressive (holistic) styles of early language acquisition. Longitudinal observation of 41 preschoolers (23 children of the referential strategy and 18 children of the expressive strategy) with annual testing of the formation of language and motor functions demonstrates significant differences in the prevalence of the development of somatosensory functions of the posterior cortex in children of the referential style and kinetic functions of the anterior cortex in children of the expressive style. Children of the first group develop better analytical language functions (phonemic analysis, lexical generalizations), children of the second group develop synthetic language functions (phonemic synthesis, deployment of an utterance). At the same time, children who demonstrate signs of analytical or holistic styles of early language acquisition are reliably differentiated according to high-level signs of the corresponding cognitive styles, such as the ability to categorize, assurance in the certainty of the transmitted information, the tendency to rely on verbal-logical or empirical knowledge. Therefore, there is a relationship between markers of reliance on the functions of the posterior or anterior cortex and cognitive indicators that differentiate adult carriers of an analytical or holistic culture. Thus, the formation of an analytical or holistic culture may be due to the predominance of carriers of the corresponding cortical configurations in the synchrony. The predominance of carriers of the analytical cognitive style, based on the functions of posterior cortex, forms the predominance of high-level markers of the analytical culture; the predominance of representatives of the holistic style, based on the functions of anterior cortex at all stages of ontogenesis, forms the prevalence of holistic markers in the synchrony of culture. It is the predominance of carriers of certain cortical configurations that determines the likelihood of reproduction and dissemination in culture of memes generated by carriers of the same cortical configuration. At the same time, fluctuations in the number of carriers of one or another cortical configuration determines the dynamics of changes in the characteristics of culture in diachrony.

## OP-22 The Effects of Rewards on Rapid Trial-and-Error Learning in School-Age Children

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Humans have the remarkable ability to respond quickly to changes in local conditions. This adaptability, a hallmark of intelligence, is critical for survival and everyday function. Humans cannot perform the same habitual actions over and over because real-world environments are variable, unpredict-

able, and full of novel situations. Therefore, children must acquire the skill to adapt through rapid trial-and-error learning, which involves condensing vast world knowledge into a task-specific action. Trial-and-error learning is a reward-driven process in which humans get rewards for their actions, and through just a few attempts they learn which subsequent action is optimal. Despite the prevalence of rapid trial-and-error learning, the key role of rewards, and the importance of its development during childhood, the impact of positive versus negative rewards on children's rapid trial-and-error learning is unclear and findings from the broader literature are mixed.

In the current study, we used tool-use as a model system to understand whether and how rewards affect children's rapid trial-and-error learning. A total of 56 school-aged children (M=10.4-year-old, SD= 2.5, range of age: 6.0 – 15.8; 28 girls) played an online "virtual tool-use" game in which children need to put an object (a tool) in a 2D environment to get a ball into a dedicated area. To test the effects of rewards on trial-and-error learning, we provided children with scoring points. Each participant was randomly assigned to one of three groups: (1) PR—children received a higher positive score for success compared to a negative score for failures; (2) NR—children received a higher negative score for failures compared to a positive score for success; (3) NS—children received no scoring. We examined differences between the groups in strategy, the number of attempts, success rate, and time to complete the task.

Differences in rewards elicited changes in strategy during rapid learning. Children in the NR group got higher success rates, with fewer attempts and a slower pace compared to children from the PR group who used more attempts at a faster pace. The groups also differed in strategies—the NR group were more persistent with the selected tool and its placement. Critically, those differences were dependent on children's educational system and age. We also found that self-reported individual skills such as planning, mathematics, and competitive character played a role in the effects of rewards.

Our findings demonstrate that rapid trial-and-error learning in school-age children is affected by the ratio between gains for success and penalties for errors. Further studies are conducted now to explain the nature of the mechanism, in particular the variations in the learning context. Our study has implications for improving teaching practices, suggesting that a variety of approaches in teaching how to acquire adaptive behaviour skills would be beneficial to address the differential effects of rewards based on the individual characteristics of children. Taken together, the findings suggest that rewards should be considered when investigating and modelling the development of human adaptability.

## OP-23 Relational reasoning in Turkish-speaking preschoolers: The role of object focus and executive functions

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Relational reasoning, the ability to infer patterns among individual objects, develops throughout the preschool years. Children's object focus and EF skills could influence the trajectory of it (Christie et al., 2020; Richland et al., 2006). For example, object properties such as stimuli complexity can hin-

der relational reasoning (Son et al., 2011). The differences in objects versus relation focus has been argued to explain the cross-cultural differences in relational reasoning (Christie et al., 2020). Similarly, relational reasoning performance decreases as the task's EF requirements increase (Richland et al., 2006). Yet, existing studies have not investigated other examples of object focus, such as stimuli familiarity and mentioning object properties. Further, none of the studies examined differential relationships between different EF skills and relational reasoning performance. Thus, we investigated the role of object focus (i.e., stimulus familiarity, mention of object properties) and EF skills (working memory and cognitive flexibility) in Turkish-learning preschoolers' relational reasoning.

We recruited 41 48- to 72-month-olds in an online study (Mage=59.01, SD=6.46). We measured children's relational reasoning with a relational match-to-sample task consisting of 12 trials (RMTS; Premack, 1983), manipulating the stimulus familiarity having half of the trials with unfamiliar and the remaining half with familiar shapes. We coded children's responses as relational match or not and children's use of color or shape names during the trials. Next, we measured children's cognitive flexibility by the short version of the dimensional change card sort task (DCCS; Zelazo, 2006) and calculated the total score out of 5 post-switch trials. Finally, we measured children's working memory by Turkish Word Span task consisting of forward and backward trials (Adıgüzel, 2021) and calculated the number of correctly recalled trials for each.

First, a repeated-measures ANOVA showed no significant association between stimulus familiarity and relational reasoning, controlling for age ($F(1,39)=1.017$, $p=.320$). Children performed significantly above chance level in both familiar ($t(40)=4.64$, $p<.001$) and unfamiliar conditions ($t(40)=4.64$, $p<.001$). Next, a glmer model for relational match performance investigated the fixed effect of using object properties, DCCS score, Forward span, Backward span. The model showed fixed effects of using object properties (B=-.91,SE=.306,p=.030) and backward span (B=.375,SE=.126,p=.003). That is, the probability of choosing a relational match was associated negatively with the use of object properties and positively with the backward span.

Our results are the first to show the differential contribution of different EF skills and object focus in relational reasoning. We showed that although mentioning object properties hindered children from reason relationally, maintaining and manipulating verbal information in mind (indicated by backward span) facilitated relational reasoning. These results highlight the importance of child-related variables (e.g., EF) and more direct measures of object focus. Additionally, as relational reasoning differs cross-culturally (Christie et al., 2020), it is important to show Turkish children's performance, which has not been investigated before.



## OP-24 Effective requests in parent-child interactions

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As part of becoming a cooperative member of a given social group, young children need to learn how to follow requests by group members. Guidelines for effective communication can be found,

for example, in therapy manuals for children with externalizing disorders (e.g., THAV, Görtz-Dorten & Döpfner, 2010; THOP, Döpfner et al., 2013). However, the empirical basis for these guidelines is still weak. A review over single case studies (Radley & Dart, 2016, Clinical Child and Family Psychology Review) identified „effective instruction delivery" (EID) as a useful strategy for increasing child compliance. EID was defined as keeping eye contact, providing praise for compliance, and using directive statements.

The current study explored the effectivity of parental requests to cooperate in a tidy-up situation in an ecologically valid situation at home (child age: 2-6 years; N = 54, 30 females). Parental phrases and behavior as well as children's verbal and non-verbal responses were transcribed and double-coded. Parental requests were coded regarding grammatical form, content, timing and accompanying behavior (helping, directive gestures...). Child responses were coded for compliance and committed compliance (showing particular motivation to comply), and supplemented with information on children's proactive compliance (without prior parental request). In addition, all videos were rated for the general quality of caregiver-child interaction. Overall, compliance and committed compliance were expected to increase with age. Based on the parental education literature, it was hypothesized that positive and directive statements, praise for compliance, leaving time for the child to respond, parental cooperative behaviors, and a playful mode embedding the request enhance child compliance. In contrast, threatening with negative consequences and criticizing the child were expected to decrease compliance.

Currently, a total of N = 39 videos have been transcribed and double-coded. Preliminary evidence indicates that criticizing the child decreases compliance, whereas praise increases compliance. The remaining videos are currently coded and GLMs will used to test the hypotheses regarding the effects of different request modes with the entire data set. In addition, correlations between global ratings of interaction quality with child compliance will be examined.

This field-study will provide ecologically valid evidence on how caregivers best communicate with young children to help them follow requests in cooperative task settings.

## OP-25 Five-year-old children care more about their reputation following interaction with robots

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Humans often exhibit prosocial behavior to enhance their reputation. Prior studies show that children manage their reputation when they are observed by others. However, no studies have examined whether children care about their reputation from robots. Since robots are becoming involved in children's lives, it is urgent to know how children perceive robots and how they change their behavior in front of robots. The present study assessed whether 5-year-olds act prosocially in the presence of a robot. We also investigated whether children show more reputational concerns if they interact with the robot.

Participants were Eighty-four 5-year-olds (M = 61.07 months), most of whom came from middle-class Japanese families. Children were randomly assigned to one of three conditions: a social robot (n = 28, 14 boys), a still robot (n = 28, 14 boys) and a flower image (n = 28, 13 boys). In the social robot condition, children interacted and played with the robot, which was programmed to engage in communicative exchanges based on an AI system. In the still robot condition, the same robot as the social robot condition was displayed, although children did not have an opportunity to interact with the robot. In the flower condition (control condition), a flower stimulus was displayed at the same position where the robot stood in the other two conditions. After that, children were given 10 stickers and asked to divide them between themselves and an absent recipient. During the distribution, the social robot, the still robot, or the flower stimulus was placed in front of children. We coded the number of stickers distributed to the recipient.

Results showed that children shared 4.71 stickers (SD = 2.27) in the social robot condition, 3.21 (SD = 2.17) in the still robot condition, and 3.39 (SD = 2.28) in the flower condition. We analyzed the mean number of stickers using a one-way ANOVA with condition (social robot, still robot, and flower) as between-subject variables and observed a significant main effect of condition ($F(2, 81) = 3.74$, $p = .028$, $\eta 2 = .084$). Post hoc analyses (Bonferroni) revealed that the mean number of stickers in the social robot condition was significantly higher than that of the still robot condition ($p = .014$) and the flower condition ($p = .030$). There was no significant difference between the still robot and flower conditions ($p = .766$).

Our results demonstrated that 5-year-olds strategically managed their reputation and shared more stickers with a recipient when being watched by a social robot than by a still robot or a flower stimulus. This study is the first to show that 5-year-olds care about their reputation from robots after their interactions. Our findings have implications in societies engaged with robots, suggesting that introducing social robots in children's lives will positively impact their prosocial behavior.

## OP-26 Need or Offer? Developmental Changes in Resource Allocation in Market

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The "right" thing to do in a market is to distribute resources differentially based strictly on amount offered in return. However, the buyers might also differ in their need for the resources. How to allocate resources between two buyers whose needs are in conflict with the amount they offer forms a moral dilemma as to distributive justice. We investigated how children (N = 64; 5-6-year-olds, Mage = 6.02 years, SDage = 0.59; 9-10-year-olds, Mage = 9.94, SDage = 0.66) and adults (N = 32; Mage = 22.31, SDage = 2.80) solve this dilemma when allocating necessary and luxury resources between two buyers. In baseline conditions, participants of all age groups favored the recipient who was in

greater need (no offer information presented) and the recipient who offered more (no need information presented), and there were developmental increases in the considerations for needs and offers respectively. In the conflict condition in which we pitted needs against offers (i.e., a buyer needed the resources more but offered less money vs. a buyer needed the resources less but offered more money), developmental changes emerged. We found that: 1) only 5-6-year-olds and 9-10-year-olds distributed more resources to the recipient in greater need despite the lower offer, although the distribution patterns in the two groups were different. Specifically, 5-6 years old children valued need only, and did not distinguish between necessary and luxury resources; whereas, 9-10 years old children incorporated the concerns for others' needs and offers into their allocation decision, though they weigh needs higher and did so to a larger extent when distributing necessary resources than luxury ones. 2) Compared to children, adults valued offers more than children did. That is, adults weighed offers and needs equally when allocating necessary resources, and tended to give higher priority to offers when allocating luxury resources. These results suggest that children only value others' needs at first. With age, they come to increasingly incorporate market norms into their conceptions of distributive justice, as evidenced by adults weighing market norms as important, or even more so, as others' needs when determining the fair allocation of resources.

## OP-27 Examining the Effectiveness of an Online Dialogic Book Reading Program to Support Vocabulary and Comprehension Skills of Children from Low-SES Families

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Research shows that dialogic book reading, which involves asking children open-ended questions and encouraging their participation in the story construction, supports children's language and literacy skills (e.g., Whitehurst et al., 1994; Zevenbergen & Whitehurst, 2003). Children in today's digital era are exposed to both traditional and digital book reading interactions (Krcmar & Cingel, 2014). The COVID-19 pandemic has further accelerated this digitalization process. Schools worldwide implemented remote education programs during the pandemic and turned their in-class activities into online activities. Preschoolers from low socioeconomic status (SES) backgrounds were particularly disadvantaged during this period due to the lack of resources. This research examines the effectiveness of an online dialogic storybook reading program for 4-to-5-year-olds from low-SES backgrounds who have not attended any preschool before. A total of 28 children participated in this study. Parents first completed the informed consent form and the demographics questionnaire. During the pre-test, we assessed children's receptive vocabulary using the Turkish Receptive Language Test (TIFALDI), and expressive vocabulary using an expressive vocabulary test asking about the target vocabulary in the storybooks. We also measured children's narrative comprehension skills using a subtest of the Test of Narrative Language (TNL). Participants were matched for vocabulary and comprehension skills based on their pre-test scores before being assigned to experimental

conditions. There were two experimental conditions: 1) book reading with open-ended questions (n=10), 2) book reading with close-ended questions (n=11), and a control condition (n=7) who did not participate in any book reading program. During the post-test, we assessed children's expressive vocabulary using the same test. We also assessed children's narrative comprehension skills using a different subtest from TNL. Children in the experimental conditions participated in book reading activities in groups of 5-6 via a mobile video conferencing program. The experimenter shared the screen with children. In the first experimental condition (book reading with open-ended questions), the experimenter read 4 different storybooks over 4 weeks. Reading sessions took place twice a week, and the experimenter used the dialogue-based book reading method, asking the children "why" and "how" questions. In the second experimental condition (book reading with close-ended questions), the experimenter read the same storybooks for 4 weeks. In this condition, book reading sessions happened twice a week again, but this time questions were about the pictures and descriptive features (e.g., "What is this?" "What color is the mammoth?"). A 3 (condition: open-ended, close-ended, control) X 2 (time: pre-test and post-test) ANOVA was conducted to examine whether children's expressive vocabulary knowledge and narrative comprehension increased from pre-test to post-test and whether there were differences across conditions. The findings showed that children's expressive vocabulary knowledge and narrative comprehension scores were significantly higher in the post-test than pre-test for experimental conditions but not for the control condition. Children in open-ended and close-ended questions benefited similarly from the book reading program. These findings suggest that dialogic book reading can be successfully adapted to online interaction contexts and can effectively facilitate children's participation in the activity and support their language skills in diverse SES contexts.

## OP-28 Learning about Coronavirus at School: Children's Questions and Teacher's Responses about COVID-19 Pandemic in Turkey and the US

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Children gain knowledge about phenomena in the world that they cannot fully observe or explain by asking questions to knowledge adults around them (i.e., parents, teachers) (Harris, 2012). Studies in the U.S. and Europe emphasize the importance of children's question-asking behavior in everyday conversations for learning and cognitive development (Chouinard, 2007; Callanan & Oakes, 1994; Butler, Ronfard & Corriveau, 2020). The Covid-19 epidemic, which has affected the whole world, has also affected the daily lives of children and their conversations with adults. Research has shown that children ask questions about the virus, school, lifestyle changes, and precautions when talking to their parents, and parents give informative answers to these questions (Menendez et al., 2021; Ünlütabak& Velioğlu, 2022). With the resumption of face-to-face classes in schools, children have begun to ask their questions about the COVID-19 outbreak not only to parents but also to teachers.

However, there has not been any research examining children's questions and teachers' responses about Covid-19 pandemic.

The study addressed this gap in the literature by examining 3-12-year-old children's questions and teachers' responses about Covid-19 pandemic in two sociocultural contexts: Turkey and the U.S. A total of 130 teachers from Turkey and 77 teachers from the U.S. participated in the study in December 2021. Via an online questionnaire, teachers were asked to report 3 questions about Covid-19 pandemic asked by students and the responses they gave for these questions. In addition, teachers filled out a demographics questionnaire asking them about their education level, age, gender, and professional experience.

When we examined the types of children's questions, we observed that children mostly asked yes/no questions (44% Turkey, 33% US) and what questions (30% Turkey, 20% the U.S.) in both cultural contexts. Children in Turkey (19%) asked fewer explanation-seeking why/how questions than children in the US (34%). When we examined the contents of the children's questions, we observed that children mostly asked about preventive measures(27% Turkey, 28% the U.S.) and the virus (23% Turkey, 17% US). When we examined the answers given by the teachers to these questions, in both cultures, the most common themes were realistic (65% Turkey, 45% the U.S.) and reassurance (12% Turkey, 7% the U.S). As for the causal content of the responses, teachers in Turkey mostly made explanations by referring to a prior cause (49%) and specifying conditions (24%) while teachers in the U.S referred to consequence (31%), mechanism (10%) and conditions (10%). The findings provide important implications for how children gain knowledge in interactions with teachers when discussing topics related to health, disease, and virus in two cultural contexts.

## OP-29 The Motivation Behind Early Deception in 2 ½-5-year-olds

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Deception is a common experience and an integral part of our social life, and it emerges early in development, by 2 ½ years of age (Evans & Lee, 2013). In the past two decades, developmental researchers have identified social cognitive factors that explain how deception emerges. The abilities to mentalize (i.e., theory of mind) and to inhibit one's own desires (i.e., inhibitory control) are two of the critical ingredients which contribute to early deception (Sai et al., 2021). However, it remains an open question in terms of why deception emerges. In other words, what motivates young children to produce their first lies? The current study examined what the motivation behind early deception is and how it changes in development.

A modified third-party transgression paradigm was used to capture children's propensity to deceive to cover up a minor rule violation. Two hundred and seventeen 2 ½ -5-year-old children participated in the study. Children were assigned to one of the three motivational conditions: 1) ambiguous condition; 2) self-motivated condition; and 3) other-motivated condition. In the ambiguous condition, children's deception could be either self- or other-motivated; in the self-motivated condition, their lies could only be attributed to a self-serving motivation; and in the other-motivated condition, their

deception could only be interpreted as out of a regard for others. In the paradigm, deception was coded through both verbal (i.e., verbal denial) and nonverbal measures (i.e., physically covering up the transgression).

Results show that 2 ½ -4-year-old children were more likely to deceive in the ambiguous and self-motivated conditions compared to the other-motivated condition. However, 4-5-year-old children engaged in deception equally across the three conditions. The results suggest that children's earliest deception is primarily driven by a self-serving motivation. However, the motivation to deceive diversifies from around 4 years of age, when children begin to deceive for both self-serving and other-serving motivations. On the whole, the dissertation is one of the firsts to examine the motivation behind deception in very young children. The study revealed that deception is self-serving from its emergence, but by 4 years of age, children's deception is driven equally by both self-serving and other-serving reasons. This research is a first step to understand what drives the ontogeny of human deception, and how such motivation diverges in the preschool.

## OP-30 Associations across intellectual virtues: Curiosity, creativity, open-minded thinking, and academic courage

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Curiosity is essential for innovation and knowledge creation. It involves recognizing what you don't know and information seeking, but is challenging to differentiate from other types of epistemic reasoning, likely because of strong associations or similarities across constructs. These include creativity, open-minded thinking, and academic courage, which are referred to as intellectual virtues in their common involvement of the desire for knowledge, truth, and understanding (Baehr, 2013). A similar commonality around uncertainty, either in approaches toward or attitudes about uncertainty or how one responds to uncertainty, suggests that these constructs relate (Evans et al., in press; Jirout & Matthews, in press). The current work tests this hypothesis, including two aims: 1) develop a self-report survey measure of intellectual virtues (curiosity, creativity, open-minded thinking, and academic courage) for young children, and 2) use this survey to test associations across the constructs of interest. In two samples with children ages 6-10 (study 1: 7-8 questions per scale, n=44; study 2: 4-5 questions per scale, n=49) we observed moderate associations between curiosity and the other virtues (Spearman correlations from .44-.67), however the constructs didn't all relate to each other. In our third survey test, we will be collecting data in a larger sample of children, allowing us to use more advanced psychometrics to evaluate the scales as measuring distinct but related constructs. Our talk will describe the process of generating our survey, the theoretical connections among the constructs studied, and present the intercorrelations across the constructs.

## OP-31 Children Use Self-Disclosure to Infer Relationship Depth

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The present research examines how children infer relationship depth based on the type of information people disclose about themselves. Four to 12-year-old children in South Korea (N = 71) were presented with a description of a character talking about his or her own academic performances to two individuals. The character mentioned something that was likely to be reputation-enhancing to one individual (getting a top score on a test) and the other presented something reputation-undermining to another individual (getting a bad score on a test). Participants were then asked to rate the level of closeness of the character to each individual (Figure). Results showed an age-related shift in which after around age 7 children tended to infer reputation-undermining self-disclosure is a stronger indicator of a close relationship than reputation-enhancing information. These findings suggest that children use reputation management behaviors to make inferences about relationship depth, and that this tendency emerges over the course of development.

## OP-32 The relationship between young children's compliance and persistence in coordinated joint activity

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Coordinating/synchronising with others is generally seen as a positive behaviour (Mayo & Gordon, 2020; Miles et al., 2011). When adults coordinate with each other in joint activity, they may become more compliant with instructions (Wilthermuth, 2012) and persist for longer in the activity (Michael et al., 2016). However, this is not clear in developmental studies. This current study investigates to what extent four-and-a-half-year-olds comply with rules of a joint activity and persist in the activity when levels of coordination are manipulated. We look at how coordination influences compliance and how compliance relates to persistence. We also explore underlying drivers for compliance and persistence. How does coordination influence compliance? One possibility is that coordination should increase compliance because coordination increases social connection which, in turn, increases compliance (Wilthermuth, 2012). This prediction is plausible because synchrony enhances self-reported feelings of social connection in adults (Wilthermuth, 2012) and in children (Rabinowitch & Knafo-Noam 2015; Tunçgenç & Cohen, 2016). Another possibility is that coordination should increase non-compliance because increased coordination threatens children's sense of autonomy. This prediction is particularly plausible in children at an age where they are making significant developments in their understanding of freedom of choice (Chernyak & Kushnir, 2018).
Children's non-compliance does not necessarily entail that children are unwilling to engage in joint activity. After all, it is more straightforward to just leave joint activity to maintain autonomy. Thus, children who are non-compliant in joint activity may still value the social connection afforded by

the activity, but not at the expense of their autonomy. Thus, non-compliance in joint activity may indicate desires for autonomy and social connection at the same time. Thus, one may predict that non-compliant children may persist longer in the activity.

This study addresses a gap in research by investigating children's levels of non-compliance and persistence in different degrees of coordinated joint activity. In a between-subjects design, there were three conditions manipulated by an adult play partner (N=72): A) low coordination; B) high coordination; or C) high coordination with ostensive cues. We explored how non-compliant four-and-a-half-year-olds (41 girls, 31 boys) were in baseline rounds of the activity and how persistent they were for the duration of the activity where they were being tempted to leave the activity by another experimenter. The activity involved taking balls one-by-one from a dispenser and putting them into a house on the other side of the room. We define non-compliance as suggesting rule change and persistence as number of rounds of the joint activity that children completed. We predict increased non-compliance in higher coordination conditions due to the threat to autonomy. We also predict that increased non-compliance will lead to increased persistence because non-compliance shows engagement in joint activity. Data is currently being coded and will be analysed using mixed models. We plan to share the results at the conference.

Understanding how non-compliance and persistence operate in coordinated joint activity with young children and identifying underlying drivers may usefully be applied to parental and teacher understanding and management of children's development and behaviour.

## OP-33 The Development of Iconic Expressiveness in Deaf Children

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Iconicity, or the motivated, non-arbitrary relationship between a wordform and its meaning, is a fundamental (though understudied) property of both spoken and signed languages, present in word forms, co-speech gesture, and prosody (Dingemanse et al., 2015; Perniss et al., 2010). These non-arbitrary mappings raise questions about theories of language acquisition, which often assume the learner is acquiring a series of arbitrary mappings. In both spoken and signed languages, caregivers use features such as intonation, articulation, pitch, and repetition to increase the salience of iconic words (Laing et al., 2017) , and to enhance the iconic mapping between the form and meaning (Herold et al., 2012; Perniss et al., 2018).

Instances of iconic modification are pervasive throughout speech and sign across contexts (Fuks, 2014; Shintel & Nusbaum, 2007). Previous work has explored the ways in which this phenomenon manifests in a sign language (ASL), where the visual modality affords a high degree of iconicity, and has identified both linguistic (applying only to signers) and gestural (applying to both signers and gesturers) influences on this phenomenon. The present study explores this phenomenon in deaf children. A set of video stimuli depicting a series of verbs was developed such that "events" iconically "match" or "mismatch" the ASL sign for a verb (e.g., the ASL sign for THROW involves a forward

movement; a mismatch event might depict underhand throwing, see Figure 1). Subjects are prompted with the ASL signs for the verbs and asked to use them in their signed description (deaf subjects) or their silent gesture depiction (hearing subjects) of what happened in the videos. We will analyze their descriptions for instances of modification (e.g., changing the movement path of the sign to depict the path change in the video). In adults, previous work has found that modification is dependent on (1) the mismatch dimension of the sign (e.g, direction, speed, path), and (2) the iconicity of the sign; more iconic signs were more modifiable. In contrast, gesturers (non-signers) treated all dimensions of a sign as equally modifiable. Both groups were sensitive to the sign's iconicity; however, signers appeared to have additional constraints on their use of iconicity such as the phonology of the sign. These findings suggest that this expressive use of iconicity in language incorporates both linguistic and non-linguistic knowledge.

Little is understood about how children acquire language-specific conventions around the use of iconicity. Examining the manner in which both deaf and hearing children use iconicity in the manual modality can inform our understanding of linguistic and non-linguistic constraints surrounding its use, as well as its relation to other aspects of language acquisition. The current study provides insight into this question, by exploring the iconic, gradient, and less-conventionalized aspects of signed communication without relying on modality to distinguish language from gesture. By studying the development of this skill in deaf children using ASL we will gain a better understanding of how this expressive and gradient aspect of the language comes to be incorporated into a signer's communicative repertoire.

## OP-34 Reduced social responsiveness in infancy as an early behavioural marker of later developmental outcomes in typically developing infants and infants at risk for autism spectrum disorder

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Prospective studies of autism assess infants with a familial history of autism, typically an older sibling (1). Despite the empirical study (e.g., 2, 3), reliable later predictors of autism remain elusive in the first year of life. Keemink et al. (2021) used a gaze-contingent paradigm with typically developing (TD), and infant sibling (IS) groups in which engaging in eye contact with on-screen actors would trigger the stimulus to produce a facial expression. In addition to eye movements, the infant's response (e.g., a smile) to the stimulus was recorded. Eye movements were comparable between groups, but the infant sibling group showed reduced behavioural responsiveness. We are currently conducting follow-up work with infants tested by Keemink et al. to assess whether reduced social responsiveness is related to later outcomes via a parent-child free-play task and standardised developmental assessments (TheRepetitive Behaviour Questionnaire-2 (RBQ-2), Language Use Inventory (LUI) and Ages and Stages Questionnaires-3 (ASQ-3)). Followed-up participants comprised 45 TD infants (21 – 56 months) and 10 IS children (42 – 60 months). Using a task modelled on the Parent-Child Free

Play procedure (e.g., 5-7), parents and children were recorded while engaging in free-play. Following previous research (e.g., 8-10) a coding scheme evaluated five measures of social interactivity, including social vocalisations, smiling and engagement in play. Parental-reports, the RBQ-2, ASQ-3 and LUI were completed online separately. Results revealed that infants who responded less during the eye-tracking task were less socially vocal in the interaction task, and infants in the IS group with low responsiveness showed significantly less social vocalization relative to low scoring TD infants ($p < 0.006$). Findings also indicated that smiling in the eye-tracking task in infancy is associated to later contingent responsiveness ($F (1,49) = 4.097$, $p = 0.048$, $\eta p2 = 0.077$). Results from standardised developmental assessments indicated that infants who responded less during the eye-tracking task had less developmental assessment score in ASQ-3 ($F (1,49) = 4.183$, $p = 0.046$, $\eta p2 = 0.079$) and also an association between imitation behaviour in infancy and developmental assessment score of ASQ-3 in early childhood ($F (1,49) = 4.084$, $p = 0.049$, $\eta p2 = 0.077$) was found. These findings suggest that reduced social responsiveness in infant siblings in the first year of life is associated with later social and general development and may be useful in predicting ASD in infancy before a formal diagnosis is established.

## OP-35 Development of social attention: critical analysis of the current research

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Traditionally, selective attention is considered to be driven by the perceptual properties (salience directed) (Theeuwes, 2010) and task relevance (goal directed) (Wolfe, Cave, & Franzel, 1989) of stimuli that allow children to build knowledge about their surrounding environment and make decisions accordingly. However, the last decade of developmental research has led to more adjusted models combining several other components such as context, reward history and learning abilities (incidental or active), all contributing to the allocation of attentional resources (Anderson, Laurent, & Yantis, 2011; Chelazzi, Perlato, Santandrea, & Della Libera, 2013; Kim & Anderson, 2021; Matyjek, Meliss, Dziobek, & Murayama, 2020; Suri & Gross, 2015). When applied to the social world, the models of selective attention now consider how the salience, reward value of social stimuli (especially human faces) and child's motivation may lead to children' orienting depending on the environmental (e.g. teaching) context. However, the mechanisms underlying the development of social attention are still poorly understood. Further conceptualization of the mechanisms that drive social attention is required not only to better understand typical development of social attention but also the arising social orienting vulnerabilities observed in clinical populations. Here, I present an up-to-date critical analysis of the current literature concerning the effects of motivational salience (intrinsic or acquired) on attention to faces as well as the influence of the required levels of social orienting on motivated behavior, with the goal to provide a key contribution to ongoing and future discussions and theoretical developments of this field of research.

## OP-36 Better Together: Classroom-Based Social Intervention for Spatial Skills

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Spatial skills underlie how humans acquire, represent, organize, and navigate the environment; mentally manipulate objects; and communicate information about objects and environments to others. While educators have increasingly realized that early interventions in reading, writing, and arithmetic have cascading effects that lead to academic and professional success, an intentional practice of spatial skills is largely absent from schools' curricula. The current study builds on prior research to develop a social educational intervention to strengthen spatial skills and science interest in young children, while ensuring its feasibility in a classroom setting. Specifically, we examined the value of training spatial skills as a group at reception age.

Young children (n = 45; 20 girls; M = 5.4±0.8 years) were trained in 2- and 3-D shape construction games once a week for 35 minutes as part of their school curriculum. The intervention lasted six weeks, and children were randomly assigned to one of three groups: (1) "social" group: children in this group completed a unique, innovative group intervention in which subgroups of four children played the spatial games; (2) "individuals" group: children in this group played an individual version of the spatial games and completed the entire training by themselves; and (3) "no-spatial" group: children in this group completed a non-spatial activity and were used as a control to the other groups. Children were assessed at their school before and after the intervention on picture rotation, spatial vocabulary (receptive and expressive), mental transformation, maths and science reasoning. The intervention was video recorded and the children's social dynamics during the intervention was coded. The social group showed greater improvements in all spatial and reasoning assessments compared to the other groups. Children in the individuals group showed more improvement than children in the no-spatial group. Yet, we did not find any differences in post-intervention math assessments between the groups. Importantly, the group dynamics in the subgroups predicted children's improvements in the post-intervention spatial and reasoning assessments. We also found that children from low socioeconomic status (SES) benefited significantly more from the social interactions compared to children from high SES.

Findings show the benefits of classroom-oriented spatial-skills training in primary-school children on their spatial and reasoning skills. Our works highlight the added value of practising spatial skills as a group and the potential of facilitating spatial skills from a young age, when spatial competence is developing and neuroplasticity is high. Finally, we propose that social intervention is particularly beneficial for children from disadvantaged backgrounds.

## OP-37 Is the moon already up for infants' early acquired nouns?

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Oh look up there is the moon! Even young infants experience referents in a specific spatial context, thus these experiential traces might already relate to the corresponding label (Zwaan & Madden, 2005). When presented with a referent word associated with an up location, adults typically respond faster with an up response, than a down response and vice versa (within tasks requiring manual responses, e.g. Lachmair et al., 2011 and within task requiring eye movements, Dudschig et al., 2013). There is evidence that word processing of directional words leads to attentional shifts (Hommel et al., 2001) and biases vertical eye movements towards the (implied) spatial position of the processed words (Ostarek et al., 2018) in adults. A spatial-compatibility effect for manual responses was already found for preschoolers between 4 and 7 years (Vogt et al., 2019), but it remains open whether language-space associations are established when words are learned during infancy and whether these associations are automatically activated by infants and toddlers. We followed up on these questions in a pre-registered study (https://osf.io/ez7c6/?view_only=69f49ab36fb04d2e89a40df4f908a6cb). So far, we collected eligible data of 30 adults (M = 21.13 years), 12 toddlers between 24 to 46 months (M = 36.17 months) and 11 infants between 11 and 14 months (M = 12.36 months). Within our adapted target detection eye-tracking task (Bulf et al., 2016), participants first heard one out of ten referent words (associated either with an up or down location) followed by a face-like stimuli appearing either in an upper or lower position on the screen. The implied position of the referent word could either be compatible to the upcoming position of the target stimulus, or incompatible. Crucially, the implied position of the referent word was only in 50 % of trials a valid cue for target position. We measured the time it took participants to successfully fixate the target stimuli for 100 ms. Our preliminary results suggest that toddlers and adults were faster to fixate the target stimuli in compatible compared to incompatible trials: Adults were on average 16.55 ms faster and toddlers 69.66 ms. For infants, we found the reversed trend: They were on average 83.27 ms faster in the incompatible trials compared to the compatible trials. Exploratively, we investigated whether participants spontaneous eye movements were biased while listening to the referent word. Again, we found evidence for spatial bias in eye movements for adults and toddlers: Even before they've seen the target appear they looked more to the upper part of the screen after hearing an up word, compared to hearing a down word. We did not find the same pattern for the infants. Together, our preliminary results suggest spatial biases as response to the implied position of referent words in adults and toddlers eye movements, but not yet for infants around their first birthday. At this point, with small sample sizes we reframe from further interpretations until we reached our pre-registered sample size and conducted our planned analysis.

## OP-38 Children decide third-party punishment for bystanders according to their situation

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Sometimes, bystanders are attributed responsibility or are punished, even when they are not involved in the wrongdoer's offensive act or behaviors (Pereira & van Prooijen, 2018). Although previous studies have revealed that children engage in giving third-party punishment to the wrongdoers (e.g., Jordan et al., 2014; Marshall et al., 2019), it is unclear how they evaluate and punish the bystanders. This study examined whether 6- to 8-year-old children engage in giving third-party punishment to bystanders and whether their evaluation of the bystander changes depending upon the situation (i.e., the bystander's physical environment or social relationship).

Seventy-two children aged 6- to 8-year-old participated in the experiment and were divided into 3 conditions: no-barrier, barrier, and ingroup. In the task, the children were shown a movie in which a victim is deprived of their toy by a wrongdoer, and a bystander watches without intervening. In the no-barrier condition, there was no physical barrier between the bystander, victim, and wrongdoer, that is, they were in the same space. In the barrier condition, the bystander could not intervene the interaction between the victim and the wrongdoer due to the physical barrier. In the ingroup condition, the bystander and wrongdoer were ingroup members, while the victim was not. The membership between the bystander and wrongdoer was indicated by wearing the same-colored clothing. In addition, there was no physical barrier among the three characters. After watching the movie, the children were provided with an opportunity to be able to punish the characters by reducing the number of cookies from the default number which were planned to be distributed to the victim, bystander, and wrongdoer. Children were also asked to indicate whether they perceived the character's behavior as good or bad on a 5-point Lickert scale.

Results revealed that children, in all conditions, reduced more cookies from the wrongdoer than the victim and bystander, and more cookies from the bystander than the victim. However, the degree of punishment for the bystander was lighter in the barrier condition than the no-barrier and ingroup conditions, and it was not significantly different between the latter two conditions. Furthermore, we found that the good-and-evil judgment to the bystander predicted the degree of punishment, and there was no interaction between the good-and-evil judgement and the conditions. These results revealed three things. First, the physical environment of the bystander affected the children's degree of third-party punishment to him, suggesting that the children would exempt the bystander from punishment because of his inability of intervene. Second, the relationship between the bystander and the wrongdoer as an ingroup did not affect the children's degree of third-party punishment to the bystander. Third, children judge the degree of punishment according to their good-and-evil evaluation of the bystander. These results suggest that children judge the degree of punishment according to individual behavior, not membership. Taken together, children evaluate bystanders considering their situation and do not make uniform evaluations.

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# 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*

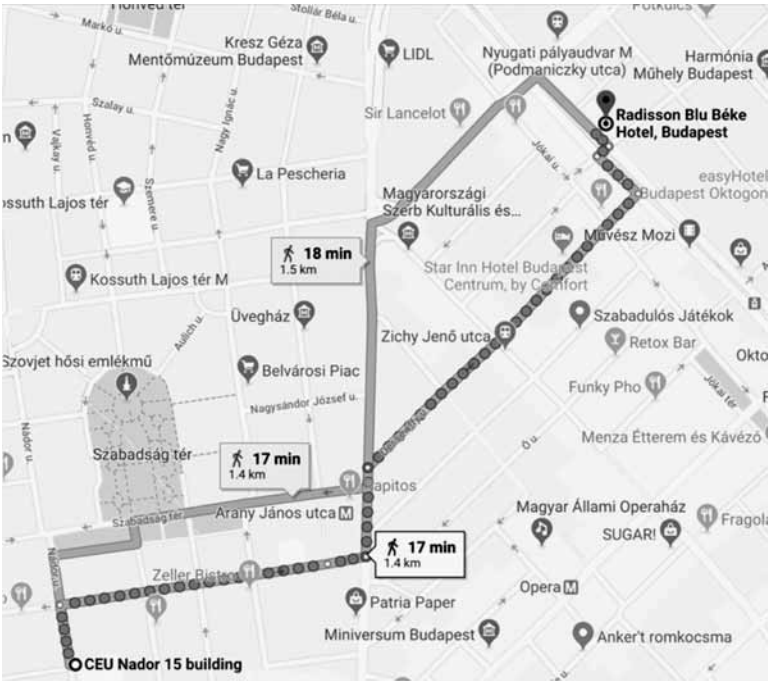
**19 BOMBAY BUDAPEST** €€
Október 6 u. 17, 1051, Budapest
*Indian restaurant*

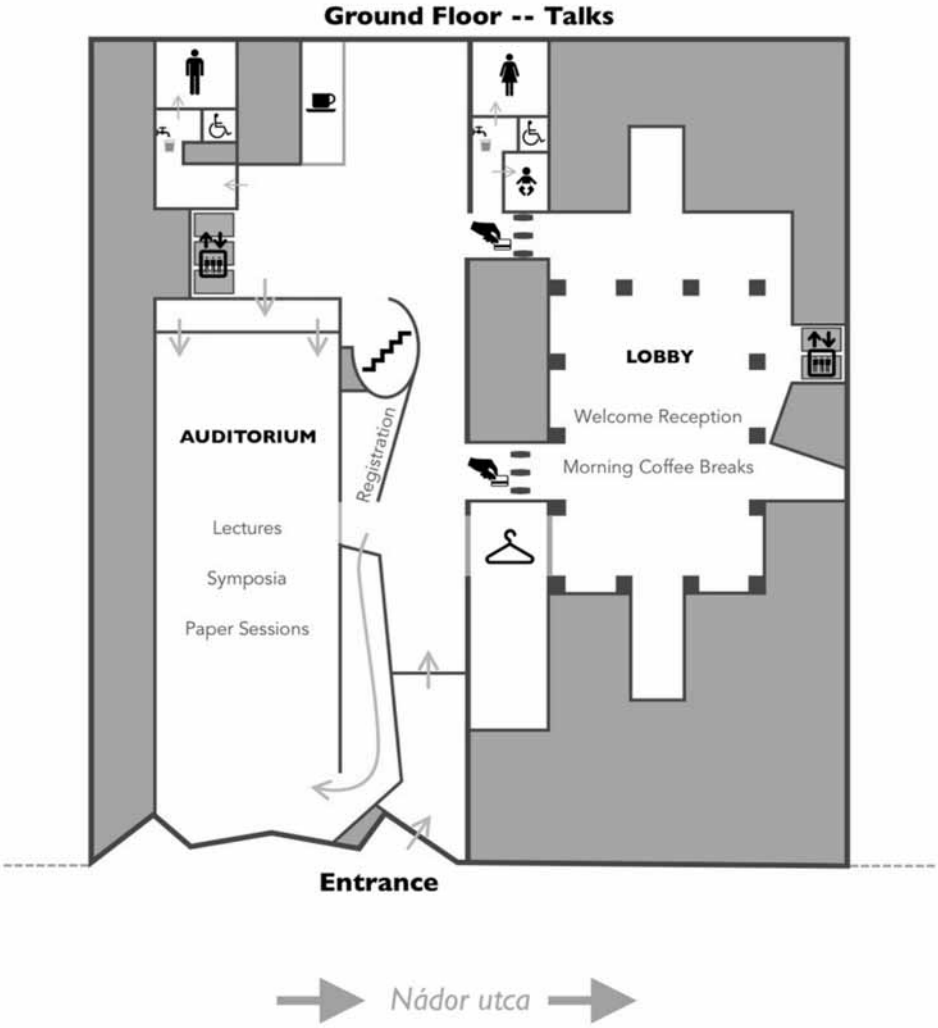
**20. HOPPÁ! BISTRO** €-€€
Október 6 u. 15, 1051, Budapest
*Hungarian restaurant with French twist*

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

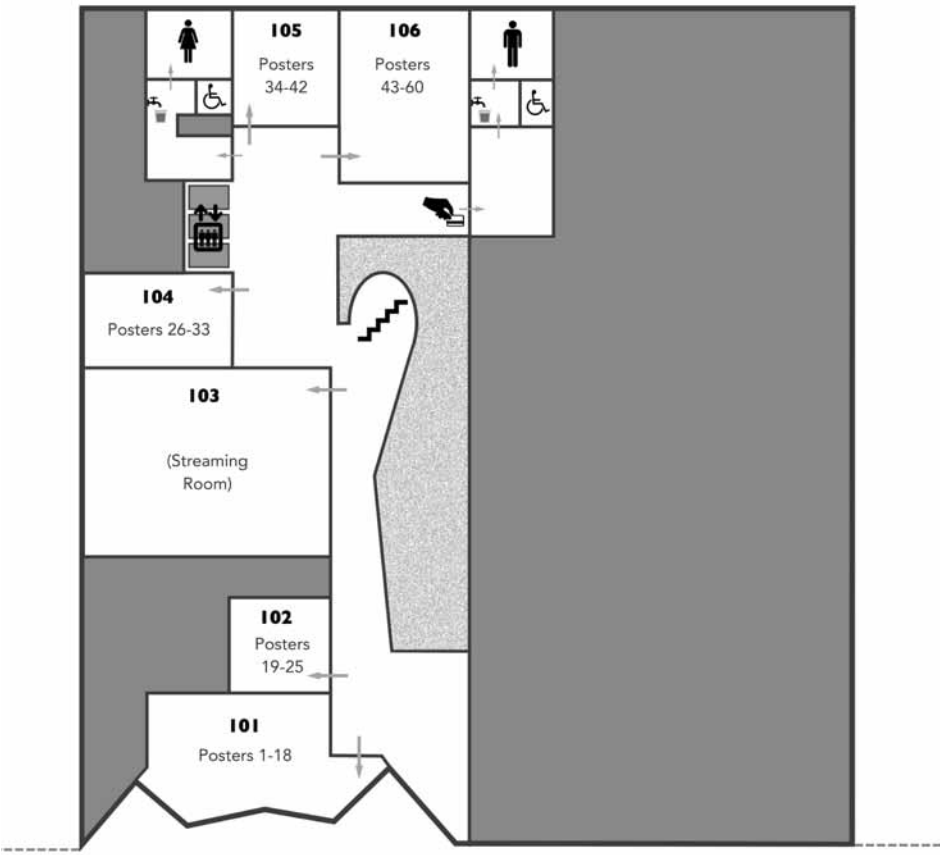
**22. POKITO** €€
Nádor u. 17, 1051 Budapest
*Hawaii superfood, poke bowls, fish*

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


Kresz Géza
Mentőmúzeum Budapest
LIDL
Nyugati pályaudvar M
(Podmaniczky utca)
Harmónia
Műhely Budapest
Radisson Blu Béke
Hotel, Budapest
Sir Lancelot
La Pescheria
Magyarországi
Szerb Kulturális és...
Művész Mozi
18 min
1.5 km
Kossuth Lajos tér M
Star Inn Hotel Budapest
Centrum, by Comfort
Üvegház
Szabadulós Játékok
Zichy Jenő utca
Retox Bar
Szovjet hősi emlékmű
Belvárosi Piac
Funky Pho
Nagysándor József u.
Menza Étterem és Kávézó
Szabadság tér
17 min
1.4 km
Arany János utca M
Magyar Állami Operaház
SUGAR!
17 min
1.4 km
Opera M
Patria Paper
Miniversum Budapest
Anker't romkocsma
CEU Nador 15 building


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

## First Floor -- Posters



BC3D

BUDAPEST
CEU CONFERENCE
ON COGNITIVE
DEVELOPMENT

# NOTES

CEU CENTRAL EUROPEAN UNIVERSITY