



Lancaster
University



**8TH LANCASTER INTERNATIONAL
CONFERENCE ON INFANT AND EARLY
CHILD DEVELOPMENT**

23-25 AUGUST 2023

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We are thankful to the staff and students who have dedicated their time and effort to help organise the conference and to the sponsors who made it possible!



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LOCATIONS

LCICD will take place on the Lancaster University Campus, in the **Management School** building. If you stay in town, you can comfortably reach the campus by bus (until stations 'Underpass' – please note that buses will not be serving the Underpass during the conference, they will be stopping at the Chaplaincy Centre instead – or 'Management School'). The registration desk will be available in the Hub area.



-  Management School Building.
-  University Print Shop
-  Gala Dinner at Barker House

You can also use [Mazemap](#) (click or scan the QR-code on the right) to find your way around campus.



LCICD 2023

WELCOME!

Dear LCICD 2023 attendees,

Welcome to Lancaster! This is already the 8th instalment of our conference, and we are very happy that it seems to have become a fixed entry in the calendar of so many infant and early child development researchers from around the world.

Once again, we breached previous submission records with over 120 submissions this year. We were also able to provide a higher number of hardship fund grants than before, in line with the spirit of inclusivity that we believe is a characteristic feature of LCICD.

As in previous years, we are looking forward to spending time in person with like-minded people and learning about the latest developments in our field in a relaxed and friendly atmosphere. There will be ample opportunities to experience cutting edge research, discuss views on infant and early child development, socialise, and eat well. We hope you will enjoy your time and will come away from the conference with new ideas, good feedback on your work, new friendships, and happy memories.

Gert Westermann
Katharina Kaduk
and the LCICD Organising Committee



SCHEDULE DAY 1 (Wednesday, 23rd August 2023)

08:30 - 09:30	Registration
09:30 - 09:45	Welcome
09:45 - 10:45	<p>Keynote 1: Meredith Rowe</p> <p style="text-align: center;">How, when, and why infants' early gesture use predicts language development <i>Moderator: Katherine Messenger</i></p>
10:45 - 11:45	<p>Talk session 1 <i>Moderator: Iris Nomikou</i></p> <p style="text-align: center;">Good point! Do gestures predict language development? <i>Presenting author: Samuel Forbes</i></p> <p style="text-align: center;">Multimodal communication during circle-time interactions: Educators' use of language, gestures, and materiality <i>Presenting author: Ana Moreno-Núñez</i></p>
11:45 - 12:15	Coffee Break
12:15 - 13:15	<p>Talk session 2 <i>Moderator: Julie Bertels</i></p> <p style="text-align: center;">Infants' visual statistical learning abilities benefit from early exposure to the environment <i>Presenting author: Lauréline Fourdin</i></p> <p style="text-align: center;">Visual exploration, a predictor of executive function from 30 to 54 months <i>Presenting author: Eleanor Johns</i></p>
13:15 - 14:15	Lunch Break
14:15 - 15:45	Poster Session 1
15:45 - 16:15	Coffee Break
16:15 - 17:45	<p>Talk Session 3 <i>Moderator: Sylvain Sirois</i></p> <p style="text-align: center;">Maternal touch predicts self-development in infants <i>Presenting author: Nina-Alisa Kollakowski</i></p> <p style="text-align: center;">Attention sharing helps attention focusing: Relations between infants' focused attention and joint attention with caregivers <i>Presenting author: Berna A. Uzundağ</i></p> <p style="text-align: center;">The development and maintenance of sustained individual interest in young children – A longitudinal study <i>Presenting author: Rajalakshmi Madhavan</i></p>
From 19:00	Conference dinner (Barker House Farm)

SCHEDULE DAY 2 (Thursday, 24th August 2023)

08:30 - 09:00	Registration
09:00 - 10:00	<p>Keynote 2: Rhodri Cusack</p> <p>Using neuroimaging and deep learning to understand brain development in helpless young infants <i>Moderator: Gert Westermann</i></p>
10:00 - 11:00	<p>Talk session 4 <i>Moderator: Hannah Stewart</i></p> <p>Infants' pupil dilation to sounds correspond to parental ratings of sensory sensitivity <i>Presenting author: Giorgia Bussu</i></p> <p>A maturational frequency discrimination deficit may explain developmental language disorder <i>Presenting author: Samuel Jones</i></p>
11:00 - 11:30	Coffee break
11:30 - 13:00	<p>Talk session 5 <i>Moderator: Samuel Forbes</i></p> <p>Mapping the development of the intrinsically photosensitive retinal ganglion cells (ipRGC) pupillary system in Infants <i>Presenting author: Pär Nyström</i></p> <p>Visual attention development in infancy <i>Presenting author: Ingmar Visser</i></p> <p>Rate expectations: Using pupil acceleration to predict habituation <i>Presenting author: Sylvain Sirois</i></p>
13:00 - 14.00	Lunch Break
14:00 - 15.30	<p>Talk session 6 <i>Moderator: Tom Fritzsche</i></p> <p>Voice onset time in Norwegian infant directed speech: A longitudinal study on the relationship between consonant production in parents' IDS and infants' babbling <i>Presenting author: Nina Hatlevoll</i></p> <p>Selective attention to articulating mouth across infancy: Sex differences and longitudinal associations with language outcomes <i>Presenting author: Itziar Lozano</i></p> <p>Effects of maternal gaze on infant brain activity and word segmentation</p>

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	<i>Presenting author: Monica Vanoncini</i>
15:30 - 16:00	Coffee Break
16:00 - 17:00	Talk session 7 <i>Moderator: Samuel Jones</i> Walking and falling: Using robot simulations to model the role of errors in infant walking <i>Presenting author: Ori Ossmy</i> First “Where” and then “How”: Developmental processes in exploring solutions to problems with hidden demands <i>Presenting author: Ori Ossmy</i>
17:00 - 19:00	Poster session 2, Reception <i>Canapes and drinks served during poster session.</i>

SCHEDULE DAY 3 (Friday, 25th August 2023)

08.30 - 09:00	Registration
09:00 - 10:00	<p>Keynote 3: Markus Paulus</p> <p>“The ontogenetic emergence of prosocial action” <i>Moderator: Charlie Lewis</i></p>
10:00 - 11:00	<p>Talk session 8 <i>Moderator: Christian Kliesch</i></p> <p>Using functional near-infrared spectroscopy (fNIRS) to assess the interplay among malnourishment, brain connectivity and behavioral outcome in 12-month-old Bangladeshi children <i>Presenting author: Renata Di Lorenzo</i></p> <p>Neurocognitive development from birth to preschool age, and its association with caregiver-infant interactive style, in a rural area of the Gambia <i>Presenting author: Bosiljka Milosavljevic</i></p>
11:00 - 11:30	Coffee break
11:30 - 13:00	<p>Talk session 9 <i>Moderator: Angel Tovar</i></p> <p>Use of transfer learning and image models to categorize infant vocalizations in audio recordings <i>Presenting author: Arun Prakash Singh</i></p> <p>Young children and adults use reasoning by exclusion, rather than attraction to novelty, to disambiguate novel word meanings <i>Presenting author: Natalie Bleijlevens</i></p> <p>A data-driven approach to characterize young children’s vocabulary development <i>Presenting author: Hiromichi Hagihara</i></p>
13:00 - 13:15	Awards and closing remarks
13:15 - 14:00	Lunch

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KEYNOTE SPEAKERS



How, when, and why infants' early gesture use predicts language development

Meredith Rowe

Harvard University

There is much evidence that children's early gesture use precedes and predicts their later language development. Yet there is still much to learn about the nature of this relationship. In this talk I draw on existing literature as well as some new studies in our lab to describe: 1) *how*, or in what specific ways, early gesture is associated with language development, 2) *when* in early development different types of gestures are most predictive of later language, and 3) *why* these relationships might exist. Finally, implications for encouraging gesture use in caregiver-child interactions as a way to promote language development are discussed.

Using neuroimaging and deep learning to understand brain development in helpless young infants

Rhodri Cusack

Trinity College Dublin

Language, motor control, and other functions are primitive in human infants for around a year after birth but mature rapidly thereafter. What is the cause of this delay? It might be because the corresponding brain systems need time to mature before they are ready to function. Alternatively, these systems may function from birth, but need to gather experience of the environment before overt behaviour can develop. To distinguish these alternatives, we used neuroimaging with MRI to probe the selectivity and connectivity in the brain, and deep neural networks to create computational models of learning. Across domains, we found converging evidence that cognitive systems are surprisingly mature, and that even high-level systems are functioning, supporting a neuroconstructivist perspective that the delay in the development of cognition is due to a need to acquire experience, rather than to the immaturity of the brain.

The ontogenetic emergence of prosocial action

Markus Paulus

Ludwig Maximilian University of Munich

The development of prosocial behavior has become a topic of vivid interest. Toddlers have been shown to help, comfort, and share with others. Despite the rich evidence on the existence of prosociality in young children, the developmental origins are unclear. In this talk, I will sketch a theoretical framework that highlights how early prosocial behavior is routed in infants' early social experiences. I will argue that prosocial behavior becomes increasingly other-oriented and altruistic in the course of early childhood.

PAPER TALK ABSTRACTS



Session 1

Wed 23rd August, 10:45 - 11:45

Good point! Do gestures predict language development?

Samuel Forbes, Lauryn Clucas, and Zahra Mollaie

Durham University

Gestures, such as pointing, waving or nodding, give important cues to language learners, and are a key communicative tool. In infants, gesture use and comprehension has been shown to be predictive of language abilities, and may even be a path through which infants can bootstrap language learning. However much of the existing findings have been based on observations of children over a short space of time, and focused on children learning English as their first language. As gesture usage has a considerable cultural component, it is crucial to investigate this phenomenon cross-culturally. Here we present convergent evidence from both a high-density longitudinal dataset, and a cross-linguistic cross-sectional dataset which demonstrates the interactions between gesture use, gesture comprehension and language development in infants. Crucially evidence suggests that gestures confer specific advantages in word learning, but do not lead to general advantages such as an increase in vocabulary size. This extends to benefits for learning the same types of word as the gestures, such as increased knowledge of action words with action-related gestures. We then compare these findings to the longitudinal dataset, where we can trace how exposure to gestures influences language output over the first years of life. These findings illustrate that gestures may have an important role in developing the infant vocabulary, but that this role might also be specific and limited, and only targeted use might confer language-related benefits.

Multimodal communication during circle-time interactions: Educators' use of language, gestures and materiality

Ana Moreno-Núñez, Marta Baltasar, Lucía Martín-Lillo, Araceli Medina, and Marta Casla

Universidad Autónoma de Madrid

Adopting a multimodal point of view is key to fully understand the role of Child Directed Speech (CDS) in early linguistic development, which means considering gestures as part of the communicative and linguistic system (Perniss, 2018). Previous research has shown that adults adapt their gestures to children's linguistic level and that the use of gestures is related to early linguistic development (Rowe & Goldin-Meadow, 2009). Yet, little is known about how adults use gestures during group interaction in educational settings, especially in early childhood education and care (ECEC) centers. Furthermore, adult-children interactions in these settings differ from home dyadic interactions in a number of ways, including how objects and spaces are incorporated for the promotion of children's participative opportunities (Bautista et al., 2020; Cárdenas et al., 2020).

This study aims at analyzing teachers' coordination of gestures and verbal utterances during group interaction with two-year-old children, considering the type of gesture, the use of objects and the spatial arrangement of children in the classroom. We video-recorded 16 teachers during circle-time sessions in Spanish ECEC centers. Typical circle-time activities are designed as a verbal dialogic encounter, which also includes songs, shared book-reading, and storytelling. We used CHAT software from the CHILDES project (MacWhinney, 2000) for transcribing teachers verbal utterances, and ELAN annotation software (Lausberg & Sloetjes, 2009) for coding the type of gestures (pointing, instrumental, symbolic, conventional, and rhythmic), the use of objects, and children's spatial arrangement (circle, lines, 'L' shape and undefined).

Results show that teachers accompany their verbal utterances with gestures more than 50% of the time, and that 25% of these gestures include using objects. Conventional gestures were the most frequent, followed by symbolic and pointing gestures. As expected, teachers used objects more often when performing instrumental gestures than with other type of gestures. We also found significant and negative correlations between teachers' use of conventional gestures and instrumental gestures. Interestingly, the proportion of each type of gestures differed from class to class according to children's spatial arrangement.

These findings suggest that the coordination of verbal and nonverbal strategies could be related to the particular characteristics of the educational setting in which group

interactions take place. We discuss the need to consider the implications of materiality into children's responses to each type of teacher's communicative bid.

Session 2

Wed 23rd August, 12:15 -13:15

Infants' visual statistical learning abilities benefit from early exposure to the environment

Lauréline Fourdin¹, Morgane Colin¹, Dominique Grossman², Florence Christiaens³, Arnaud Destrebecqz¹, Alec Aeby³, and Julie Bertels¹

¹*Université Libre de Bruxelles*, ²*Hôpital Delta (CHIREC)*, ³*Hôpital Universitaire de Bruxelles (H.U.B)*

Many studies have highlighted the infants' ability to extract regularities in their environment. These statistical learning (SL) abilities are of primary importance since they form the basis of children's abilities to organize and form coherent representations of the external world. How the constraints linked to cerebral maturation and to the infant's experience with their environment interact with SL mechanisms remains an open question.

Using an infant-controlled habituation paradigm in which three doublets of shapes were presented randomly, one shape at a time, we examined infants' ability to differentiate between sequences of shapes of high, low, and null transitional probability (TP), after habituation. We tested 8- and 10-month-old full-term infants, and very preterm infants at 8 months of adjusted age. Preterms were therefore paired on postmenstrual age (i.e., the age calculated since conception) with the youngest full-terms – that is, they share the level of cerebral maturation but have more ex-utero experience, and on chronological age (i.e., the age calculated since birth) with the oldest full-terms – that is, they share the amount of experience with the external world but have less mature brains.

In both the habituation and test phases, we observed an association between global looking times and post-menstrual age, with 8-month-olds and preterms looking more to the shapes than 10-month-olds. The attention devoted to visual stimuli would thus mostly depend on cerebral maturation. In the test phase, results revealed a typical developmental pattern: while 8-month-old full-terms showed a familiarity preference (i.e., they looked more at high and low than at null TPs doublets), 10-month-old full-terms showed a novelty effect. Critically, preterms likewise exhibited a novelty effect. These findings thus demonstrate that preterms benefit from their early exposure to regularities outside the womb, and support that, at that age, visual SL abilities depend more on experience than on cerebral maturation.

Visual exploration, a predictor of executive function from 30 to 54 monthsAmanda Eleanor Johns¹, John Spencer¹, and Samuel Forbes²¹University of East Anglia, ²Durham University

Executive function (EF) is a set of cognitive skills involved in integrating attention shifting, working memory, and inhibitory control processes (Miyake et al., 2000). EF improves dramatically from 3 to 5 years (Carlson, 2005; Diamond, 2013, Garon et al., 2008). Research examining EF yields conflicting information regarding the component factors that underlie EF during this period. Providing a conceptualisation of EF structure and developmental trajectories during this transitional age will enable fine-grained understanding of EF and the cognitive processes underlying EF development. Here, we asked whether visual cognition can concurrently and longitudinally predict EF abilities.

To investigate this, looking behaviour was examined at 30-, 42-, and 54- months in a visual working memory task (VWM; see Ross-Sheehy et al., 2003; Wijekumar et al., 2019). Children visually explored a display with colourful squares blinking on the left and right of the screen. On one side, squares changed colour after each 'blink'; on the other, the colours remained the same. Three memory loads were presented: low load (two squares on each side), medium load (four squares), and high load (six squares). The Minnesota executive function scale (MEFS; Carlson & Zelazo, 2014) was used as our index of EF.

We first examined EF using a linear mixed effects model containing MEFS total score, year of test, and maternal education. Results show a significant positive interaction of maternal education and total score across years, with toddlers with a higher educated mother obtaining a higher total score. To examine visual cognition as a predictor of EF, we examined proportion of looking to the changing side in the VWM task when children's first look was to the changing side. This measure captures detection of novelty and sustained looking to novelty. We found a significant interaction between 30-month looking (year 1), total score across years, and maternal education, with higher proportion of looking at 30-months predicting higher EF at 30-, 42-, and 54-months, particularly for toddlers with a lower educated mother. We hope to include further models of these findings, alongside measures of spatial and executive attention, to track the developmental trajectories of EF and establish the components involved in EF development during early childhood.

Session 3

Wed 23rd August, 16:15 - 17:45

Maternal touch predicts self-development in infants

Nina-Alisa Kollakowski¹, Carolina Pletti², and Markus Paulus¹

¹LMU Munich, ²University Vienna

Recent accounts proposed a central role of embodied interactions between caregiver and child for the emergence of the self in infancy (e.g. Ciaunica & Fotopoulou, 2017), especially by providing a stream of multimodal information that serves as a learning opportunity for detecting sensorimotor contingencies. These sensorimotor contingencies, for example delivered through (affective) touch or the contingency of the caregiver's reaction to the cues of the infant, have been proposed to form the basis of infant's bodily self (e.g. de Klerk, Filippetti & Rigato, 2021). To investigate whether caregiver-child interactions indeed influence the development of the infant's self, we assessed the infant's self at 5-months. We measured the infants' looking times towards a spatially contingent or non-contingent view of their legs in a looking preference paradigm after Rochat & Morgan (1995). Additionally, we measured the infants' brain activation while watching a temporally contingent vs. non-contingent video of their face with fNIRS (see Filippetti, Lloyd-Fox, et al., 2015). Furthermore, maternal touch and mothers' contingent reactions were assessed from 119 mother child-dyads. Children preferred looking at the contingent view in the looking preference task ($n = 111$, $M_{\text{contingent}} = 99.92$ s, $M_{\text{non-contingent}} = 65.62$ s, $p < .001$). In the fNIRS task, infants showed significantly more HbO activation to the contingent than to the non-contingent view ($n = 44$, $M_{\text{contingent}} = 0.29$ μMol , $M_{\text{non-contingent}} = -0.20$ μMol s, $p = .01$) in a channel located over the left superior temporal sulcus. The performances in both tasks were not significantly correlated ($n = 42$, $r = -.10$, $p = .73$). Mothers on average spent 61.9% of the interaction touching the infant. This was significantly correlated to the fNIRS activation ($n = 41$, $r = -.41$, $p = .005$) but not to the looking preference task measure. The mean number of maternal contingent reactions per minute was 18.88. These were not related to both self-measures. Our results indicate that self-related contingency detection in the temporal and spatial domain might not rely on a common ability. Future research could investigate these abilities become interconnected later in life. Maternal contingent reactions did not predict the bodily self of infants., maybe because these contingencies are rather distal in relation to the infant's body. To our knowledge, this study is the first one to show that maternal touch relates to the infant's self-related brain activation, supporting theories claiming that caregiver-child interactions promote the infant's self-development.

Attention sharing helps attention focusing?: Relations between infants' focused attention and joint attention with caregivers

Berna A. Uzundağ and Nursena Koç

Kadir Has University

Attention is a fundamental ability upon which complex skills are thought to be built (Colombo & Cheatham, 2006). Infants' ability to sustain attention has been linked to intelligence, vocabulary, and self-regulation (e.g., Johansson et al., 2015; Kannass & Oakes, 2008). Although the ability to focus attention is generally viewed as a temperament-based ability (Posner & Rothbart, 2000), recent studies suggest that sharing attention with caregivers (i.e. joint attention) and parental talk and manipulation of objects might foster infants' ability to focus their attention (Suarez-Rivera et al., 2019; Yu & Smith, 2016). However, these findings come from studies measuring both joint attention and focused attention within the same parent-infant interaction. It is not yet known whether joint attention in parent-infant interactions is related to infants' focused attention when playing alone without parental intervention. The present study aims to examine the relationship between joint attention and focused attention in infants aged between 9 and 16 months, when attentional control skills continue to develop.

81 infants (37 girls; age range=9-16 months; $M(SD)=11.9(1.4)$) and their mothers participated in the study (data coding ongoing for additional 29 infants). Infants' focused attention was assessed by individual play with one toy (2-min) and five toys (6-min). To assess joint attention, mothers and infants engaged in 10-min free-play with 7 age-appropriate toys. By using video recordings, focused attention was coded when infants looked at an object with a serious facial expression and manipulated the object by touching/mouthing (Kannass & Oakes, 2008). An interaction was coded as joint attention (JA) if both the mother and the infant looked at the same object for at least 3 seconds (Tomasello & Todd, 1983). The number of JA episodes, total duration spent in JA, and the average duration of JA episodes were coded.

Results showed that infants who spent a higher percentage of time in JA with their mothers ($M(SD)=73.2(12.1)$) spent a higher percentage of time in focused attention ($M(SD)=62.4(20.7)$) when playing alone with multiple toys ($r=.23$, $p=.04$), but not with one toy ($r=.03$, $p=.79$). These novel results may suggest that infants who spend more time in shared attention with their caregivers learn how to sustain their attention on multiple objects for longer periods of time on their own. Longitudinal findings will shed more light on the direction of this relationship (longitudinal data collection ongoing).

The development and maintenance of sustained individual interest in young children – A longitudinal study

Rajalakshmi Madhavan and Nivedita Mani

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Primate Cognition*

Caregivers of young children report their children being particularly and intensively interested in certain objects and toys from their environment (Chi & Koeske, 1983; DeLoache et al., 2007), and learning and retaining information about these objects better as they actively elicit the information from their caregivers (Mani & Ackermann, 2018). While such interests are shown to develop as young as 18 months, it is still unknown how such interests develop across early childhood and how they influence language development. Against this background, the current study takes a longitudinal look at the development of children's interests in particular object categories in their environment, with regard to children's interest in natural object categories as indexed by (1) parents' estimation of children's category knowledge, (2) parents' estimation of their child's interest in particular categories, (3) and physiological (pupil dilation) responses to objects from different categories. Specifically, we examine whether (a) parent estimates of children's interests at 18-months are associated with their evaluation of their child's interests at 24-months; (b) children's pupillary arousal in response to familiar objects on screen at 18-months predict their pupillary response at 24-months, and (c) children's vocabulary knowledge at 24-months is associated with parent estimations of children's interest and children's pupillary arousal at 18-months. Fifty-eight children were tested at two points in time; first at 18-months and later, at 24-months. For the pupillary arousal measure, we presented children with images of objects from different categories and measured their pupillary arousal time-locked to object presentation. Parents completed two questionnaires aimed to estimate (i) their child's interests and (ii) vocabulary knowledge, at the same points in time. Preliminary analyses show that (a) parent estimates of interests at 18-months is positively associated with parent estimates at 24 months; (b) children's pupillary arousal to categories at 18-months is not associated with their pupillary arousal at 24-months; and (c) children's category-specific vocabulary knowledge at 24-months is significantly associated to parent estimates of children's interests at 18-months. Taken together, this study documents the longitudinal relationship between children's interests, parents' awareness of their children's interests and later vocabulary development.

Session 4

Thu 24th August, 10:00 - 11:00

Infants' pupil dilation to sounds correspond to parental ratings of sensory sensitivity

Giorgia Bussu¹ and Terje Falck-Ytter^{1,2}

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Phasic bursts of arousal change the way the brain processes information. Previous work has shown that pupil dilation responses can be used as a reliable and easy-to-use method for measuring phasic arousal and estimating sensory thresholds and salience in large experimental cohorts and across species^{1,2}. Individual differences in physiological reactivity to sounds may be linked to personality traits³ or sleep across development⁴. Nevertheless, modulation of pupil-related physiological reactivity by sound volume levels has not been tested early in infancy, nor has it been linked to infant measures of behavioral reactivity and regulation.

In this study, we used repeated measure ANOVA to analyse eye-tracking data from 5-month-old infants ($n=32$; $n=18$ males) who attended to a visual stimulus preceded by auditory cues at different volume levels (i.e., 0dB, 20dB, 30dB, 40dB, 50dB, 60dB, 70dB). Modulation of phasic arousal was measured by average amplitude of pupil dilation response to the sounds, then linked to parent-reported measures of negative affect, night awakenings and sensory sensitivity through partial correlation analysis, accounting for sex and age (see the pre-registered analysis plan: <https://osf.io/vrd4h>).

We observed a monotonic association whereby louder sounds induced a larger pupil dilation response ($F(6,186)=21.7$, $p<0.01$, $h^2p=0.41$). Steeper slope of pupillary response to increasing sound volume was significantly associated with lower sensory sensitivity, as measured by the ITSP5 (Kendall's $t=-0.36$, $p=0.005$), while associations with temperament and sleep were not significant.

Increased pupil dilation response with sound volume might index higher cognitive control in service of regulation, reflected in reduced sensory sensitive reactivity in everyday life. Taken together, our findings provide promising evidence for the use of pupillometry to investigate cross-domain associations between physiological and behavioral regulation.

A maturational frequency discrimination deficit may explain developmental language disorderSamuel Jones^{1,2}, Hannah Stewart², and Gert Westermann²¹Bangor University, ²Lancaster University

Auditory perceptual deficits are widely observed among children with developmental language disorder (DLD). Yet the nature of these deficits and the extent to which they explain speech and language problems remain controversial. In this study, we hypothesise that disruption to the maturation of the basilar membrane may impede the optimisation of the auditory pathway from brainstem to cortex, curtailing high-resolution frequency sensitivity and the efficient spectral decomposition and encoding of natural speech. Given the typical time course of basilar membrane maturation, this disruption may occur prenatally and disrupt neural optimisation during infancy. A series of computational simulations involving deep convolutional neural networks that were trained to encode, recognise, and retrieve naturalistic speech are presented to demonstrate the strength of this account. These neural networks incorporated biologically truthful inner ear models developed to model human cochlea function, which – in the key innovation of the current study – were scheduled to mature at different rates over time. Delaying cochlea maturation qualitatively replicated the linguistic behaviour and neurophysiology of individuals with language learning difficulties in a number of ways, resulting in: (i) delayed language acquisition profiles; (ii) lower spoken word recognition accuracy; (iii) word finding and retrieval difficulties; (iv) ‘fuzzy’ and intersecting speech encodings and signatures of immature neural optimisation; and (v) emergent working memory and attentional deficits. These simulations illustrate the many negative cascading effects that a primary maturational frequency discrimination deficit may have on early language development, and generate precise and testable hypotheses for future research into the nature and cost of auditory processing deficits in children with language learning difficulties.

Session 5

Thu 24th August, 11:30 - 13:00

Mapping the development of the intrinsically photosensitive retinal ganglion cells (ipRGC) pupillary system in infants

Pär Nyström

Uppsala University

Background: Sleep is critical to infants' neural development, and light entrained circadian rhythms is a developmental milestone that appears after approximately 8 weeks (Dennis & Ross, 2005; Mirmiran et al., 2003). The light entrainment of sleep/wake patterns is highly dependent on a photoreceptor in the retina called intrinsically photosensitive retinal ganglion cells: ipRGCs (Chen et al., 2011), that project directly to the suprachiasmatic nucleus (SCN) which orchestrates the day/night circadian rhythm. The functioning of ipRGCs has been measured in adults using pupillometry, but no previous studies has assessed infants.

Objective: To investigate the development of the ipRGC pupillary system in infants and explore its potential relationship with sleep quality.

Methods: We measured the ipRGC pupillary responses in 80 infants aged between 8 weeks and 12 months, using pupillometry when stimulating the retina with prolonged red and blue light (30 seconds; Hellmer & Nyström, 2017). Sleep quality was assessed using the Brief Infant Sleep Questionnaire (BISQ).

Results: Our preliminary results show that the typical ipRGC pupillary response seen in adults was only present in approximately 40% of the infants older than 6 months, and not in any infant below 3 months of age. Our findings suggest that the ipRGC pupillary pathway matures at very different times between infants. Follow-up analyses will investigate whether ipRGC function is related to sleep quality as measured by the Brief Infant Sleep Questionnaire (BISQ; Sadeh, 2004).

Conclusion: Our study provides insights into the development of the ipRGC pupillary system in infants and its potential relationship with sleep quality. These findings have important implications for understanding the role of light exposure in infant sleep and neural development.

Visual attention development in infancy

Ingmar Visser

University of Amsterdam

Eye movements are a valuable source of information, next to responses and response times, for inferring cognitive states and processes. Infant research depends on eye movements to a large extent as other behavioral response modalities are hard to use in this population. Eye-movement data comes with many challenges, many basic properties are not well-known or understood. Optimal methods for defining fixations and saccades are still under much discussion. Free viewing presents a good way to study infant visual attention and provides robust developmental trends for a number of phenomena. We discuss a number of studies revealing different biases and other recurring patterns in eye movement in infants in their first year. We discuss findings in terms of bottom-up vs top-down control of attention and eye movements and the shift from saliency-based to object-based attention. The experimental results together form an interesting target for computational modelling.

Rate expectations: Using pupil acceleration to predict habituation

Sylvain Sirois

Université du Québec à Trois-Rivières

Much of our knowledge about the infant mind is derived from measures of decreasing interest in repeatedly presented stimuli, a form of learning called habituation. Habituation-related procedures are a well-established approach to studying a range of perceptual and cognitive processes in human infants. A majority of studies rely on visual habituation, and looking duration is the most common index of information processing. A typical procedure to assess whether habituation is established is the 3-3-50% criterion, wherein habituation is assumed when mean looking duration on the three most recent trials is at most 50% of the mean looking duration on the first three trials (Kucharský et al., 2022).

In the past 15 years, pupil diameter has emerged as an attractive alternative to looking time as an index of information processing, particularly because of its sensitivity to temporal dynamics (unlike discrete, cumulative looking times; Jackson & Sirois, 2022). However, whether pupillometry can assess that infants have habituated is an open question. The rate of change in pupil diameter (i.e., its acceleration) has been shown to index mental load in adults (Marek & Noworol, 1984), but so far has not been studied in infants.

In this study, 30 infants were habituated to video sequences of a hand reaching for a toy. Looking duration was used to estimate the number of trials to criterion using the 3-3-50% procedure. For each infant, acceleration of pupil diameter in the first three trials was correlated with the number of learning trials. By the third trial, mean acceleration was significantly and negatively correlated with the number of learning trials. Infants who showed a higher rate of change in pupil diameter required fewer trials to reach criterion, relative to infants with a lower rate.

The discussion focuses on the implications of these findings for habituation assessment, as well as for infant dropout rates when relying on looking time criteria (a prevailing problem). An online repository comprising the data and Matlab scripts used for the analyses accompanies this talk.

Session 6

Thu 24th August, 14:00-15:30

Voice onset time in Norwegian infant directed speech: A longitudinal study on the relationship between consonant production in parents' IDS and infants' babbling

Nina Hatlevoll, Julien Mayor, Natalia Kartushina, and Audun Rosslund
University of Oslo

When addressing infants, parents apply prosodic, segmental, lexical and other adaptations that are thought to facilitate infants' language development. For instance, Infant Directed Speech (IDS) has higher and more varied pitch, a larger vowel space, longer vowels, greater pauses between words, among others, as compared to Adult Directed Speech (ADS). While adaptations to vowel production in IDS have been extensively studied, little is known about consonants, and their results are conflicting (Malsheen, 1980; Englund, 2005; Økland, 2021). Voice Onset Time (VOT) is an important acoustic signal that distinguishes voiced-voiceless consonant pairs (e.g., /b-p/). The present study addressed the sparse research on consonants in IDS and in Norwegian by asking four research questions: (RQ1) Are VOTs longer in IDS as compared to ADS?; (RQ2) Are there developmental changes in VOT in IDS over time?; (RQ3) Is there a greater distinctiveness between voiced and voiceless stop consonants in IDS than in ADS?; and (RQ4) Is there a relationship between consonant distinctiveness and infants' production of the same consonants?

48 monolingual Norwegian mothers and fathers came to the lab and read a custom children's book to their infants (IDS) and to an experimenter (ADS). Prior to each visit, the parents filled out a Babbling questionnaire, assessing infants' speech sound production. Parents were recorded when their infants were 6, 9 and 12 months old. Embedded in the book, words with initial stops /p, t, k/ and /b, d, g/ were analyzed using Praat. In total, 7416 tokens were analyzed with a mixed model analysis. As expected, the results showed that, overall, VOTs were longer in IDS (17.6 ms, sd = 55.7) compared to ADS (4.9 ms, sd = 52.8) (RQ1: $F(1, 6.27) = 41.57, p < .001$); yet they became shorter as the infant became older (RQ2: from 22 ms to 9.7 ms; $F(1, 1593) = 18.87, p < .001$), approaching ADS's values, which remained stable over time. The distinctiveness between voiced and voiceless consonants was not greater in IDS as compared to ADS (RQ3: $F(2, 741.03) = 1.92, p = 0.147$). However, mothers had longer VOTs than fathers in both IDS and ADS, and especially longer VOTs for voiced stops in IDS, which resulted in less distinctive stop contrasts. Finally, overall, there was no significant correlation between consonants' distinctiveness and infants' production of the same consonants (cf RQ4). Explanations for the lack of the relationship, limitations and future directions will be discussed.

Selective attention to articulating mouth across infancy: Sex differences and longitudinal associations with language outcomes

Itziar Lozano¹, David López Pérez², Zuzanna Laudańska², Anna Malinowska-Korczak², Magdalena Szymtke¹, Alicja Radkowska-Palińska^{1,2}, and Przemysław Tomalski²
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Infants' attention to the mouth is thought to support language acquisition¹, although this relation has been scantily investigated longitudinally. In the typically developing population, sex differences in language development are well-documented, with females outperforming males as early as 2 years^{2,3}. Sex differences in mouth-looking might be a potential mechanism underlying sex differences in early language development. In this talk, we present a study⁴ that assessed attention to the articulating mouth and the eyes in the same infants at 5.5 and 11 months (n = 91; Polish, 49% females), between time-point changes and their relations with language outcomes in infancy (11 months) and toddlerhood (24 months). We also explored sex differences in mouth-looking.

Our results showed an age-related increase in looking to the mouth, and the magnitude of this change was associated with productive language, but only in toddlerhood. By contrast, looking to the eyes did not change and its duration at 5.5 months correlated with language development at 2 years. Exploratory analyses showed that female infants looked more at the mouth of talking faces than males, while not penalizing looking at the speaker's eyes. This unique female scanning pattern at 5.5. months predicted a female advantage in later language skills (at age 2 years).

These results suggest that attention to the articulating mouth in infancy likely plays a long-term role in language acquisition. They also indicate that increased mouth-looking in talking faces is potentially modulated by participant sex. We suggest that increased mouth-looking might be a female protective factor in language acquisition, potentially accounting for the still underexplained sex differences observed in language development. Our findings in typically developing infants open a new line of research on mouth-looking as a potential female protective factor of language acquisition in atypically developing populations with higher male prevalence in language impairments (e.g., Autism Spectrum Disorders).

Effects of maternal gaze on infant brain activity and word segmentation

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The social brain, consisting of those areas sensitive to social information, has been argued to “gate” the mechanisms involved in human language learning (Kuhl, 2006). Early preverbal interactions are guided by ostensive signals, such as gaze patterns. However, little is known about how the infant brain processes social gaze in naturalistic interactions and how this relates to infant language development. During free play of 9-month-olds with their mothers, we recorded fNIRS hemodynamic cortical activity and micro-coded different gaze behaviors (i.e., mutual gaze, maternal or infant’s social gaze) offline. Infants’ speech processing abilities were assessed with a word segmentation task. Using multidimensional joint recurrence quantification analysis (MdJRQA; Wallot & Mønster, 2023), we examined which gaze type was related to the highest infant’s hemodynamic cortical activity, in terms of Recurrence Rate. Regression modeling revealed that maternal social gaze co-occurred more often with the infant’s cortical activity compared to the other gaze types. Moreover, using recurrence quantification analysis (RQA; Wallot & Leonardi, 2018) we found that maternal social gaze also was the gaze behavior that best predicted infant’s word segmentation in terms of Entropy. The findings further support the importance of social interaction in language development, particularly highlighting maternal social gaze. This study demonstrates the potential of MdJRQA when investigating the coordination of categorical and continuous aspects in naturalistic scenarios.

Session 7

Thu 24th August, 16:00 - 17:00

Walking and falling: Using robot simulations to model the role of errors in infant walking

Ori Ossmy¹, Danyang Han², Patrick MacAlpine³, Justine Hoch², Peter Stone³, and Karen Adolph²

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What is the role of errors in learning? Commonsense suggests that errors signal the need for skill improvement and therefore inform learning. A salient penalty for errors (negative feedback) promotes learning by highlighting undesired operations and incentivizing correction of prior mistakes. This process is common for learning highly structured, formal skills. For example, in math learning, teachers and parents typically provide children with clear examples as training input and explicit negative feedback for incorrect solutions. Children then repeat the same operations with the goal of eliminating errors and minimizing negative feedback.

Yet, behavioural analyses indicate that errors are frequent but trivial as infants acquire foundational skills. In learning to walk, for example, falling is commonplace but appears to incur only a negligible penalty. Behavioural data, however, cannot reveal whether a low penalty for falling is beneficial for learning to walk. Here, we used a simulated bipedal robot as an embodied model to test the optimal penalty for errors in learning to walk.

We trained the robot to walk using 12,500 independent simulations on walking paths produced by infants during free play and systematically varied the penalty for falling—a level of precision, control, and magnitude impossible with real infants. When trained with lower penalties for falling, the robot learned to walk farther and better when tested on familiar, trained paths and better-generalised learning to a novel, untrained paths.

Indeed, zero penalties for errors led to the best performance for both learning and generalisation. Moreover, these beneficial effects of a low penalty were stronger for generalisation than for learning. Thus, the natural variety in infant development ensures that infants will not learn “static facts” but rather generalise their skills to varied body-environment relations. Moreover, infants’ everyday errors typically incur a low penalty—falls are unimpactful, social gaffes are trivial, and grammatical errors

and disfluencies in speech receive no explicit feedback and do not impede communication.

Robot simulations corroborate prior behavioral data, and suggest that a low penalty for errors helps infants learn foundational skills (e.g., walking, talking, and social interactions) that require immense flexibility, creativity, and adaptability. Due to a confluence of factors—infants' unique body characteristics, protected environments, and social scaffolding from their caregivers—these features of the learning environment are exclusively available during infancy. At later stages, higher physical and social penalties can impede skill acquisition such as learning to ski or speak a second language.

First “Where” and then “How”: Developmental processes in exploring solutions to problems with hidden demands

Ori Ossmy¹, Danyang Han², Minxin Cheng³, Brianna Kaplan², and Karen Adolph²
¹*Birkbeck, University of London*, ²*New York University*, ³*Northeastern University*

Motor problem solving is integral to functional behaviour—how to navigate an obstacle or grasp the handle of a tool. For some motor problems, the demands are visible in the scene (e.g., a large step is required to cross an obstacle in the path). However, for other types of motor problems, the demands are not immediately apparent, requiring discovery and implementation of non-obvious, specifically designed target actions. How do young children discover whether a closed door requires pushing or pulling or that a graspable cap of a container requires a left-twisting action to open?

Exploration during problem solving was assessed in 24- to 56-month-olds (n = 47; 26 girls) by tracking how children touched a tablet screen to open “virtual cabinets” with different locks.

Strategy-driven exploration increased with age by first focusing on the appropriate area (strategy about where to act) and then on the appropriate action (strategy about how to act). Even when children did not hypothesise about where and how to solve the problem, they showed more directed than random exploration, and directed exploration increased with age. However, children did not generalise the exploration of hidden demands from one problem to another.

Our findings expand cognitive-based research on human exploration development to an earlier age and to the motor domain. We suggest that young children quickly learn that they need to narrow down the motor search space, and only then do they focus on the correct action.

Finally, humans serve as a useful baseline to evaluate the performance of artificial embodied agents. We propose our virtual cabinet task as a computational challenge for exploration in the service of a goal. The simplicity of the problem (e.g., no haptic information, limited visual scene), direct quantification of the human actions (using the tablet), and the relevance to real life (opening cabinets is a common problem with hidden demands) is ideal for comparing goal-directed exploration between children and machines.

Session 8

Fri 25th August, 10:00 - 11:00

Using functional near-infrared spectroscopy (fNIRS) to assess the interplay among malnourishment, brain connectivity and behavioral outcome in 12-month-old Bangladeshi children

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Millions of children under 5 years suffer from chronic and acute malnutrition in Bangladesh (UNICEF). Malnutrition is particularly impactful during infancy, given that it is during this period when the brain architecture supporting the foundations for the development of cognitive, motor, and social-emotional skills are built. Recent findings have started to shed light on its impact on brain development^{3,4}. Crucially, nutritional deficiencies during infancy are likely to affect cognition and behavior throughout childhood possibly leading to long-term consequences into adulthood². While a wealth of research has been conducted in low- and middle-income countries (LMICs) on the behavioral outcomes of children facing adverse circumstances (e.g., malnutrition), few studies have attempted to probe the mechanisms underlying links among malnutrition, brain development, and behavioral outcomes in LMICs. Our study uses fNIRS to investigate how functional brain connectivity (FC) in 12-month-old Bangladeshi children is related to malnourishment and investigates relations to behavior. We recorded infant brain activity, from fronto-temporo-parietal areas, during passive watching of a nonsocial cartoon. We indexed malnutrition using weight-for-length z-scores (wasted); as index of behavioral/cognitive outcome we used the Bayley Scales of Infant and Toddler Development and other measures of executive functioning. While the processing of all behavioral assessments is ongoing, here we show preliminary analyses on FC measured in wasted children and controls (defined using weight-for-length scores). We estimated FC between a set of regions selected using DevFold1. For each group, we correlated (Oxy-hemoglobin) FC measures with the Bayley raw scores. Our results show several significant positive correlations between FC and the Bayley scores indexing expressive and receptive communication for the control group, while no correlation reached significance for the wasted group. These preliminary results highlight the critical effects of malnutrition on the infant brain, which in turn seems to affect behavior. Possibly, malnourishment suppresses the brain-behavior relations emerged for the controls.

Notably, this simple fNIRS task shows sensitivity in identifying language differences between these groups.

Neurocognitive development from birth to preschool age, and its association with caregiver-infant interactive style, in a rural area of the Gambia

Bosiljka Milosavljevic^{1,2}, Maria M. Crespo-Llado^{2,3}, Ebrima Mbye⁴, Ebou Touray⁴, Tijan Fadera⁴, Mariama Saidykhan⁴, Samantha McCann⁵, Giulia Ghillia^{2,5}, Marta Perapoch Amado^{6,7}, Catherine Southard², June Pastor Larrieta^{8,9}, Laura Bozicevic³, Sophie Moore⁵, Clare Elwell⁷, and Sarah Lloyd-Fox^{1,2}

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Child neurocognitive development and its early predictors have vastly been studied in minority world contexts. Considering that 90% of children live in majority world settings¹, understanding factors that predict child strengths and difficulties in diverse settings is becoming increasingly pressing. Early interactions with caregivers are among the first sources of learning in infancy. Contingent and affirmative responses to infant communication can reinforce behaviours vital for language, motor, and self-regulatory skills. The present study uses data from the Brain Imaging for Global Health (BRIGHT) project, a prospective longitudinal study of child neurocognitive development from the antenatal period to preschool age, in a rural area of The Gambia (N=204). The aims are to examine: (1) preschool age (3-5 year) cognitive indicators of school readiness; and (2) whether maternal-infant interactive style at 1-month predicts cognitive outcomes at preschool age.

Child cognitive skills were assessed at 3-5 years (N=171) using tablet-based measures of Executive Functioning (EF) skills (working memory [WM], inhibitory control [IC], and cognitive flexibility [CF]), language, perceptual, and motor ability (Mullen Scales of Early Learning [MSEL]), and parent-report of adaptive skills (Early Childhood Development Index [ECDI2030]). Maternal-infant interactions were measured at 1-month (N=169) using a free-play assessment. Interactions were coded for maternal contingent responsiveness and infant active communication. Participant age at the pre-school visit was controlled for in analyses due to the rapid development in cognitive skills in the 3–5-year age range.

At preschool age, children showed distinct patterns of performance across cognitive tasks, but all measures were significantly correlated with each other. Similarly, maternal, and infant behaviours at 1-month showed distinct associations with preschool-age outcome measures. There was a significant association between maternal contingent responses, IC ($b=.06$, $SE=.02$, $p=.002$), and WM ($b=.22$, $SE=.09$, $p=.01$). On the other hand, infant active communication was associated with preschool MSEL scores ($b=3.35$, $SE=1.61$, $p=.04$).

Children in this setting showed distinct performance across measures of cognitive skills. Infant communication at 1-month was related to preschool age MSEL scores. Early communicative ability may potentially be a predictor of language and school readiness factors that are relevant for general preschool cognitive assessment tasks. On the other hand, caregiver responsiveness may promote self-regulatory skills, which are relevant for later EF skills. Future work will examine potential neural and attentional mechanisms that may underlie these associations.

Session 9

Fri 25th August, 11:30 - 13:00

Use of transfer learning and image models to categorize infant vocalizations in audio recordings

Arun Prakash Singh and Natalia Kartushina
University of Oslo

The identification and categorization of infants' vocalizations (into canonical vs non-canonical babbling vs cry/laugh/adult/other) in audio recordings can play crucial role in understanding infants' language and speech development in various learning environments. Recent research indicates that deep learning models trained from 'scratch' can be utilized to accomplish various audio classification tasks including classifying infants' vocalizations. These models take Mel spectrograms as input to learn about the characteristic audio features of audio clips (acoustic waveforms). However, to achieve high classification accuracy, models trained from scratch require many audio clips; even though, the achieved accuracy ranges between 64.27% and 74.69% (when using, for example, 2456 audio clips of infant and adult vocalizations, see Ebrahimpour et al., 2022).

This study addresses this limitation and examines whether pre-trained vision deep learning models, using transfer learning with spectrogram images of audio clips as input, can achieve better accuracy in classifying infant vocalizations. An open-source labelled database (Pretzer et al., 2018) of infant and adult vocalization recorded in a home environment for English-speaking families (infants wore Lena vests for 12-hour periods at 3, 6, 9, and 18 months of age) was used for this task. Despite only 1263 audio clips of infant and adult vocalizations being available, the classification accuracies of various vision deep learning models, used in the current study, ranged between 64.50% to 82.77%, which is higher, as compared to previously used models (Ebrahimpour et al., 2022) with 1263 audio clips, i.e., between 55% and 71.42% of accuracy.

This work is an important step forward towards automatic classification of infant vocalizations and highlights the potential of using deep learning techniques developed for speech and image recognition for infants' speech recognition. However, further research is required to validate the findings and control for variables such as training and testing examples for other languages. The study also suggests that such models can be utilized as research and diagnostic tools for evaluating normal versus abnormal speech development (e.g., proportion of canonical versus non-canonical babbling). Overall, the findings have important

implications for the machine learning and language development science communities.

Young children and adults use reasoning by exclusion, rather than attraction to novelty, to disambiguate novel word meanings

Natalie Bleijlevens and Tanya Behne

University of Göttingen, Leibniz Science Campus

Upon hearing a novel label, listeners tend to assume that it refers to a novel, rather than a familiar object (see Lewis et al., 2020 for a review). While this disambiguation or Mutual Exclusivity (ME) effect has been robustly shown across development, it is unclear what it involves. Do listeners use the pragmatic context (Bleijlevens et al., 2023; Bohn et al., 2022; Clark, 2015; Diesendruck & Markson, 2001) and their lexical knowledge (e.g., Lewis et al., 2020; Markman & Wachtel, 1988) to exclude the familiar object and thus select the novel one? Or is the effect, at least in early childhood, simply based on an attraction to novelty and a direct mapping of novel label to novel object (Horst et al., 2011; Mather & Plunkett, 2012)?

In a pre-registered online-study with 2- to 3-year-olds (n=75) and adults (n=112), we examined i) whether relative object novelty alone (without pragmatic or lexical information) could account for participants' disambiguation and ii) whether participants' decision processes involved reasoning-by-exclusion strategies. Participants encountered either a known and an unknown object (classic ME condition) or two unknown objects, one completely novel and one pre-exposed (novelty condition) as potential referents of a novel label. Reasoning-by-exclusion was assessed by adults' explanations and children's looking patterns ("double checks"; Halberda, 2006): Upon hearing the novel word, children were expected to switch their gaze to the distractor object before switching back to (and staying at) the target object.

Our pattern of data across measures revealed that in the classic ME condition, children and adults significantly chose the novel object and both used reasoning-by-exclusion. In contrast, in the novelty condition, children and adults chose objects randomly. Across conditions, a retention test revealed that adults remembered their prior selections, while children's performance was more fragile. These results suggest that referent disambiguation may not be based on relative object novelty alone. Instead, to resolve referential ambiguity, both young children and adults seem to make use of pragmatic and/or lexical sources of information and to engage in reasoning-by-exclusion strategies.

A data-driven approach to characterize young children's vocabulary development

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Children's early vocabulary development has been investigated by various approaches ranging from experiments to observations to parent-report questionnaires. The MacArthur-Bates Communicative Development Inventory (CDI), a checklist which parents fill in based on whether their child "says" particular words, is one of the powerful methods. The CDI has been used internationally over the past few decades, and a certain amount of datasets are publicly available, allowing researchers to explore early vocabulary development in detail. Some studies predetermined semantic and/or grammatical categories, comparing each vocabulary size. Others used a one-dimensional developmental index such as each word's age of acquisition, the age at which the proportion of "says" exceeds the 50th percentile. Although such summarized indices are needed when analyzing the high-dimensional CDI data, these top-down categorizations or uses of only a single index may limit the full potential of the rich datasets of the CDI. Here, in order to explore children's vocabulary development, we propose a data-driven approach using a machine-learning technique called a variational autoencoder (VAE). VAE is an unsupervised neural network that maps high-dimensional input data onto a dimension-reduced latent space and then regenerates data similar to the input data. The complex data can be visualized in a latent space with high interpretability. We trained a VAE model using the CDI data of the U.S. children (16-30 months, N = 5,520). In the two-dimensional latent space we adopted, the data showed a clear arc structure, whose rotation direction characterizes the transition of the total vocabulary size and whose radial direction indicates individual differences in similar vocabulary size. In the latent space, we also depicted contour plots of the probability of whether each word is "said." Based on these visualizations, we further defined each word's developmental characteristics in quantifying the following three factors: (1) vocabulary size at which each word is more likely to be "said," (2) the steepness of each word's contour, and (3) the extent in which individual differences for each word would occur. When presenting our work, we will report the results of how words can be classified based on these three factors and how these factors correlate with other existing indices (e.g., input frequency and contextual distinctiveness). Our approach will pave a new way to depict young children's vocabulary development quantitatively and comprehensively.

POSTER SESSION 1



A1 Triadic interactions as meaningful communicative scenarios: A longitudinal study in early childhood education centers

Ana Mendoza-García and Ana Moreno-Núñez

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Triadic interactions between adults, objects and infants are essential for psychological development, as they constitute spaces for intersubjective communication and favor the progressive sophistication of infants' socio-communicative skills (Carpendale et al., 2021; Moreno-Núñez et al., 2017). Adults often mediate these interactions by using objects as communicative tools to refer to the world in enriching interactive experiences (Alessandrini, 2023), for example, through shared book-reading activities. While adult mediation has been well described in mother-child interactions (Rossmann et al., 2014), their investigation in early childhood education settings is still scarce (Cárdenas et al., 2020). Aiming at depicting the longitudinal dynamics of joint action between educators, objects, and infants during the first year of life, we filmed circle-time activities in nine ECE classrooms (five for children 0–1-year-old and six for 1–2-year-olds) at three timepoints (beginning, middle and end of the school year). Data collection included parental reports on children's communicative development, and teachers reports on children engagement during different school routines.

Data analysis will focus on the adults' communicative mediators and their relationship with infants' social engagement and communicative development. Particularly, we will analyze the unfolding dynamics of triadic interactions as infants acquire better social and communicative skills. Following a mixed-methods approach, we will qualitatively characterize interactions through microgenetic video analysis and behavioral coding and will use descriptive and inferential statistical techniques for quantitative variables. Results are expected to allow for a better understanding of the linguistic and interactive environment in which babies develop. Findings could potentially inform both parental and pedagogical strategies aimed at fostering infants' socio-communicative development.

A2 Musical dynamics of early interactions in the nursery school (0-3 years)Ana Moreno-Núñez¹, Noemí Martín-Ruiz¹, and Eva Jiménez²¹*Universidad Autónoma de Madrid, Madrid, Spain*, ²*Universidad Europea de Madrid, Madrid, Spain*

Daily interactions with adults and objects are core in the early years for the development of basic skills, as they facilitate the progressive participation of infants in shared activities with others and objects (Moreno-Núñez et al., 2021). Some studies have described how these interactions are typically structured by musical components (rhythmic, sonorous and/or melodic) that underlie adults' actions. However, similar interactive dynamics has not been explored in early childhood education, where daily routines often rely on sound and rhythm to favor opportunities for children's participation and development (Liliana et al., 2014). Therefore, describing how early interactions unfold in nursery school classrooms (i.e. with children up to 3 years of age) could be informative for the design of meaningful learning spaces.

This study aims to explore interactive dynamics between educators and children and their musical structure, if any. To this goal, we propose (1) identifying the musical components of these interactions from those observed in parent-child exchanges; (2) describing the organization underlying the interactions; and (3) illustrating microgenetic variations in their structural level over time. We conducted a longitudinal study based on ecological, quarterly classroom observations during circle time activities. We videotaped interactions in 18 classrooms of public nursery schools in the Madrid region (Spain), comprising 133 children and 15 educators. Objects were used at the discretion of the educator from those available at each school. We adopt a novel, pragmatic and functional research approach based on a mixed analytical design and a combination of different software: we will qualitatively depict the characteristics observed during interactions and analyze recurrent musical patterns of the interactions through descriptive statistical techniques.

Preliminary findings suggest that adopting a dynamic approach for studying early interactions in the classroom could contribute to better understand the mediating role of adults in infant socio-communicative development. Expected results could enrich the scientific literature on early childhood education from 0-3 years of age, which is yet scarce. Additionally, they could inform evidence-based pedagogical decision making and promote quality educational practices by identifying how adults could facilitate children's opportunities for development and learning.

A3 Questioning and gesturing during the interaction in Spanish nursery-schools

Diego Iglesias¹, Silvia Cruz-Gómez², María Fernández-Arroyo², Marta Casla², and Ana Moreno-Núñez¹

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Researchers have shown that adults often start their conversations with toddlers using questions. Furthermore, questions seem to be a powerful tool to promote children's participation in back-and-forth conversations and therefore promote linguistic development (Degotardi et al., 2018). Teachers also use different type of questions during group interaction with toddlers in in Early Childhood and Education Care (ECEC) centers (Hindman et al., 2021). However, there is no agreement on the role of each type of question. Furthermore, research related to the use of questions in these settings did adopt a multimodal point of view and did not consider the role of gestures that may capture children's attention. The aim of this work is to analyze the use of teachers' questions during group-interaction with two-year-old children in Spanish ECEC centers. We adopt a multimodal point of view in which we also consider the use of gestures that are coordinated with different question types. Participants were 16 teachers that interacted with two-year-olds during circle time. Group size ranged from 6 to 16 children. We video-recorded each session and transcribed teachers' verbal utterances using CHAT programs from the CHILDES project (MacWhinney, 2000). We have developed a function in the R programming language that reads raw data in CHAT format and processes it for further analysis (e.g., descriptive or inferential statistics and natural language processing). We also coded question types and gestures using ELAN annotation software (Lausberg & Sloetjes, 2009). We considered five types of questions: (1) closed- questions (yes/no, confirm and choice), (2) label-questions, that were considered as an intermediate category between closed and open questions, (3) open-ended questions and (5) regulatory questions. Results show that questions constitute 32% of teachers' verbal utterances, and that questions were accompanied by gestures more often than the rest of the utterances. The frequency of label and closed questions (especially yes/no questions) was higher than the frequency of the other categories. Teachers used gestures with open and closed questions 50% of the time. These results suggest the need to consider those instances in which teachers are asking for information from a multimodal point of view. We also discuss the need to analyze children's responses to each type of question considering whether they are used with gestures.

A4 The role of hierarchical temporal structure of playsongs and lullabies for infant physiology and behaviour

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Infant-directed (ID) singing has traditionally been divided into playsongs and lullabies, which have distinct acoustic features and are argued to arouse and soothe, respectively (Cirelli et al., 2020; Trehub & Trainor, 1998). However, the physiological effects of playsongs and lullabies on infants do not match these assumptions entirely. While lullabies do act soothingly, playsongs are physiologically stabilising and even calming, depending on the context (Cirelli et al., 2020; Cirelli & Trehub, 2020; Trehub et al., 2015). Our study is the first to implement a novel method to measure the acoustic properties of different ID songs combined with physiological measures to investigate these effects further.

The clustering of temporal musical information across different timescales (i.e., hierarchical event clustering; Abney et al., 2014) could aid in characterising different types of ID singing acoustically. ID speech and song are more hierarchically clustered than adult-directed speech and song, suggesting that this acoustic feature may help infants distinguish different parent-infant contexts (Falk & Kello, 2017). In adult conversations, hierarchical event clustering has been shown to depend on conversation type. High-arousal conversations, like arguments, where interlocutors might need to regulate their arousal, contain more hierarchical event clustering than low-arousal, friendly conversations (Abney et al., 2014). Under the assumption that playsongs are stabilising and lullabies are soothing, we should expect playsongs to be more hierarchically clustered than lullabies.

In this study, we investigated hierarchical event clustering of playsongs and lullabies and their respective physiological (i.e., heart rate variability, HRV; and respiratory sinus arrhythmia, RSA) and behavioural (i.e., affect and vocalisations) effects on infants. Mothers sang a playsong and a lullaby to their 7-month-old infants in a semi-naturalistic laboratory setting while we recorded infant electrocardiography and behaviour (n=30). We investigated hierarchical event clustering of ID singing (n=97) by calculating the Allan Factor (AF) function (Abney et al., 2014, 2018). Preliminary analyses showed that neither hierarchical event clustering (AF: $\chi^2(1)=.09$, $p=.75$) nor

infant physiological responses (HRV: $V=221$, $p=.82$, RSA: $\chi^2(1)=2.03$, $p=.15$) differ between lullabies and playsongs, and that infant physiological responses do not correlate with hierarchical event clustering ($S=40$, $p=.42$, $\rho=-0.11$). Although we could not confirm our hypothesis, our findings show that no differences in physiological effects between playsongs and lullabies align with similar hierarchical event clustering. Next steps will include analysing infant behaviour, calculating AF coefficients in different time bins, and including random effects in models to account for individual differences in hierarchical event clustering.

A5 Child-led book talk: Using dialogic reading research to develop practitioner's understanding of language development in English early years settings

Charlotte Raby, Sarah Paxton, and Matthew Courtney
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Child-Led Book Talk is a targeted intervention for children aged 3-5, who have been identified as not currently meeting age-related developmental milestones in terms of their oral language skills. Child-Led Book Talk was developed through collaboration between two London-based Department for Education designated English Hubs. One of the core aims of the English Hub programme is to improve the teaching of early language, in response to the research evidence which indicates that, on average, disadvantaged pupils have poorer language skills when compared to their peers from more affluent backgrounds (e.g. Hoff, 2006; Virginia & Weisleder, 2013; McGillion, Herbert, Pine, Vinham, dePaolis, Karen-Portnoy & Matthews, 2016).

Since 2019, the Child-Led Book Talk programme has been delivered in over 50 Early Years settings across England. The intervention involves trained practitioners working with children on a one-to-one basis, for five to ten minutes, two to three times weekly. During each session, the child selects a book from a curated selection of texts and the adult engages them in dialogic talk focussed on the images. Staff are trained to use a range evidence-informed strategies to develop language.

The intervention is underpinned by robust research evidence which demonstrates the positive impact that dialogic reading has on children's language skills (e.g. Bus, van IJzendoorn, Pellegrini, 1995 & Moe, Bus, De Jong, Smeets, 2008) and the impact of professional development on practitioners ability to initiate and maintain longer back and forth interactions (Piasta, Justice, Cabell, Wiggins, Turnbull & Curenton, 2012).

This presentation will explore the evidence underpinning the programme, explain the challenges to successful implementation and discuss the emerging impact including changes in practitioners' competence and confidence in developing pupils' oral language skills. We will also use video footage to exemplify the programme in action.

We are currently working with the Education Endowment Foundation to further develop the programme and welcome any insights into how we can measure the impact of Child-Led Book Talk on pupils' language development.

A6 Development of decontextualized language among monolingual and bilingual one-year-olds: Intensive longitudinal studies on teacher-child interactions within ECEC settings

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The present study aimed to investigate teacher-toddler interactions within Japanese ECEC (early childhood education and care) settings through an intensive longitudinal study. Specifically, we attempted to describe how Japanese teachers' use of decontextualized language (henceforth, DL) create toddlers' rich language-learning environment. DL is a type of language/expressions displaced in terms of time, person, or place; it is to talk about 'there-and-then', not 'here-and-now' (Rowe, 2013; Sacks, 1983). Previous research shows that caregivers' use of DL predicts children's later cognitive development and school readiness (Uccelli et al., 2018; Salo et al., 2016). However, DL has mainly been studied in family contexts in Western countries. Developmental effects of caregivers' decontextualized also culturally differ between Americans and other cultures such as Chinese (Wei et al., 2020; Grimminger et al., 2020). Children could also benefit from child-directed speech from children in non-western cultures (Bunce et al., 2021; Loutatou et al., 2021). It is possible that young children may have rich and rather diversified social interactions outside their families. Specifically, how young children could benefit from non-mother-child interactions is understudied. Thus, following Pauker et al. (2018), we conducted intensive longitudinal observation studies on two specific contexts of Japanese ECEC settings: picture-book reading and morning-time teacher-toddler interactions to see the teachers' individual differences in DL in both verbal and nonverbal interactions with children. We had studied on interactions with one-year-olds in Japanese ECEC settings, where 30% of the nation's infants and toddlers spend with their peers and teachers daily. We investigated (1) how toddlers begin to learn and develop their interactional skills through child-directed talks; (2) how teachers' individual differences in their use of DL possibly affect toddlers' individual differences in their comprehension and production of DL. We collected longitudinal observation data from four one-year-old classes with monolingual Japanese and bilingual immigrant children with the focus on two distinctive daily interactional contexts. We coded all the videotaped daily interactions and statistically analyzed the proportion of the decontextualized talks by the teachers and toddlers in terms of decontextualized dimensions proposed in previous DL studies (Rowe, 2020). Our statistical analyses revealed that the two contexts elicited different types of DL and nonverbal communication both from monolinguals and bilinguals. Bilingual immigrant children's development of DL was delayed up to 3-4 months compared to Japanese monolinguals; their comprehension was moderated by teachers' early use of

multimodal linguistic inputs. They also benefitted from monolingual children's use of DL.

A7 Pre-verbal infants are sensitive to different conversational patterns according to their usual daycare modalitiesBastien Meunier¹, Maéva Thomazeau¹, Alban Lemasson¹, and Virginie Durier²¹Université de Rennes, Rennes, France, ²CNRS, Rennes, France

Mastering conversation rules is a long but crucial process at the heart of language development. Crucial because it can be involved in social integration quite early in life (preschool age). Long because the temporal structure of an interaction relies on a coordination between partners based on several cues. In children and adults, these cues are mainly vocal/verbal such as prosody, lexical, syntax... Still infants engage in so-called proto-conversation very early and then may rely on other cues. Social experiences shape various aspects of language acquisition and the development of interactional skills is no exception. We, therefore, investigated the impact of socio-demographic characteristics on the reaction to different turn-transition patterns in conversation. Three patterns were used: a turn-giving pattern where the current speaker gives explicitly the turn to the next one, a turn-taking pattern where the second speaker starts speaking after the first one stops, and an overlapping pattern where the second speaker interrupts the first one. We sampled infants across a wide range of ages (3-11 months) and showed them sketches where the three patterns were displayed. We analysed gazes' duration according to the pattern in interaction with different factors of variation such as sex, age, parents' socio-economic status, infant's daycare, and presence of siblings. Surprisingly, the main factor of variation between infants was the type of daycare, that is infant's daycare significantly influenced the reaction to turn-allocation patterns. Infants cared for by a childminder were more sensitive to a turn-giving pattern than to a turn-taking pattern. Furthermore, infants in day nursery looked longer at the second speaker after the turn-taking pattern than infants cared for by childminder or by parents. Differences in daycare may expose infants to different types of interactions, probably depending on the ratio between the number of adults and the number of infants to care for. Thus, the reference pattern, i.e. the one they see the most, differs between types of daycare. Literature on the impact of infants' daycare on language skills development is quite scarce when our study stresses the need to systematically consider a broad range of social backgrounds in infants.

A8 Does caregivers' use of iconic words drive engagement behaviours in infants?Kirsty Green¹, Marcus Perlman², and Sotaro Kita¹¹*University of Warwick, Coventry, United Kingdom*, ²*University of Birmingham, Birmingham, United Kingdom*

Iconicity is thought to play an important role in early communication. Studies have found that iconic words are among the earliest learned by infants, and they are used disproportionately often by infants and their caregivers. Iconicity may scaffold word learning by helping infants to establish referentiality, but there is growing evidence that suggests we need to look beyond reference to fully understand the role iconicity plays in language development. In this study, we examined the hypothesis that another function of iconicity is that it makes communication fun and increases infants' engagement. We examined video-recorded interactions between 18-month-old infants and their caregivers, using iconicity ratings of words to measure iconicity in the mother's speech. Iconicity ratings were assigned to transcribed words in five mothers' utterances in interactions with their infants at 18-months. 10 high and 10 low iconicity bouts for each dyad were identified by calculating the rolling average of iconicity per 5 words and focusing on a 5-second window before and after words with the highest and lowest averages. Engagement behaviours were coded according to three categories: attention, indicated by the infant's gaze being directed towards the mother or the subject of the conversation; positive affect, indicated by the infant smiling or laughing; and communicative effort, indicated by infant vocalization, verbalisation or gesture. Results generally showed evidence that high interactions were more engaging. Indicators of attention and positive affect occurred more often in high iconicity interactions, as did two of the indicators of communicative effort – verbalisation and gesture. Non-verbal vocalization was equally frequent in both high and low iconicity interactions. These findings speak to the multi-functional nature of iconicity in parent-child interactions. They suggest that one reason iconic words might be prevalent in early interactions is because young language learners and their caregivers find these words to be intrinsically fun and engaging.

A9 “Let me show you”: Two- and 5-year-olds’ use of communicative strategies when teaching others

Marina Bazhydai and Didar Karadag

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During active social learning, young children not only acquire new knowledge from others, but also share information themselves. While infants’ receptivity to others’ teaching (such as explicit ostensive and pedagogical cues) has received substantial attention, children’s own use of communicative teaching-like strategies has been under-investigated. The current study used secondary video data to compare 2- and 5-year-olds’ (N = 100 2-year-olds and N = 40 5-year-olds) spontaneous use of teaching-relevant behaviours. Children took part in interactive social learning experimental paradigms which included two key phases. During exploration, children played with a novel toy and explored its functions in presence of a social partner. During transmission, a second, naïve social partner asked children to demonstrate how the novel toy worked. We coded children’s generation of social looks at the social partner and their use of explicit verbalisations during action demonstrations (e.g., “Press here”; “This is how you do it!”) in both phases. Compared to exploration, during transmission, 2-year-olds produced more social looks and verbal instructions, but fewer when compared to 5-year-olds. These results demonstrate for the first time that already at the age of 2, before exposure to formal teaching contexts, children actively use communicative cues such as verbal instructions and social looks to convey information to less knowledgeable others. With development and advanced language skills, their use of communicative teaching strategies becomes more advanced. Active and selective uses of teaching-relevant communicative cues during transmission as compared to mere exploration in the social learning context at the age of two lends support to teaching being an early emerging, natural cognitive ability.

A10 Does curiosity enhance word learning in 20-23-month-old infants?

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The cognitive mechanisms and benefits of active learning in early child development are poorly understood. The current ongoing study investigates 20-23-month-old infants' curiosity-driven information selection in a novel word learning task, designed to identify any potential advantage for active learning over passive learning. N = 51-75, with an application of the Bayesian sequential testing principles, will be tested in three between-subject conditions. We will use gaze-contingent eye tracking to enable infants to exert choice over which of the four objects presented on a screen are labeled at a certain point in time. As we are interested in whether the freedom to select information benefits word learning, we will contrast this active learning (Curiosity) condition with two passive learning control conditions. In one control condition (Random control), which is akin to traditional ways of presenting information in word learning studies, objects will be labeled in a random order. In the other control condition (Yoked control), infants will experience a sequence of labeling events that was actively generated by another infant. Infants' learning of word-object associations will be compared across active and passive learning paradigms. We expect to observe advantages for curiosity-driven learning on subsequent label recognition. We therefore hypothesize that infants in the Curiosity condition will show better retention of novel object labels than infants in the Random and Yoked control conditions. Such a result would provide evidence that self-motivated information selection and the freedom to choose what to learn about (albeit without their metacognitive awareness) are important aspects of infants' learning in the real world, optimizing their learning by reducing referential uncertainty, and thus providing support for the learning progress theory of curiosity. Regardless of the result, this study will advance our understanding of early word learning, and of the mechanisms and benefits of active, curiosity-based learning in infants.

A11 The prevalence of information transmission in toddler-caregiver interactions across the second year of life

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Children are effective communicators of knowledge from very early on. They actively initiate interactions with others and reciprocate with others' bids for communicative interactions. In this study, we plan to investigate toddler's interactions with their caregivers in their natural settings across the second year of life. We will code one-hour-long video recordings of home observations from different age groups (13-, 18- ad 23- months) using a novel coding scheme to document the type of interactions that caregivers and toddlers initiate to meet a range of communicative goals. By employing an event-based approach, where an event starts with an infant deictic gesture (i.e., giving, holdouts, reaching and pointing) and ends when the other party involved in the interaction provides an appropriate response within a predetermined time-frame. After identifying events, these will be categorised with respect to the communicative goals that they initially intended to achieve such as sharing interest, attention or emotion, requesting an object or an action, seeking information and giving information. We will then analyse the prevalence of information transmission by toddlers in these interactions across three different time points in the second year of life. Findings of this study will not only inform us about the early communicative interactions between toddlers and caregivers but also will provide valuable insights about the developmental trajectory of children's ability to transmit information to other.

A12 Curiosity and action imitation in 18-month-old toddlers

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Children are active participants in learning. Children are better in learning novel words for categories they are interested in (Ackermann et al., 2019) and caregivers adjust their action presentations by increasing their salience and variation using “motionese” to make them more interesting (Brand et al., 2002, Meyer et al., 2021). We investigated these aspects of curiosity driven learning in 18m-olds (N=27), who, when shown toy animals hopping or sliding into a house, imitate the action’s outcome, but not its manner (Carpenter et al., 2005). We modified the salience of manner movements in three distinct ways between-subjects: (1) small, (2) large and (3) mixture of large and small hopping and sliding movements. Conditions (2) and (3) resembled motionese, potentially increasing imitation. Actions were presented within-subjects using wooden toy cars and plush animals. We recorded toy preferences using parental reports and scored behaviour during warm-up, predicting higher imitation for preferred categories.

Including the interaction between Manner and ObjectType improved model fit significantly ($\chi^2(3)=44.02$, $p<0.01$), adding Salience did not ($\chi^2(2)=1.38$, $p=.50$). Imitation was high for sliding the car (68%, CI[50%,82%]), but low for all other object-manner combinations (9–12%, CIs[2%,35%]). Outcome imitation (86%, CI[72%, 94%]) was unaffected by Manner-ObjectType interaction ($\chi^2(3)=0.36$, $p=.95$), and Salience ($\chi^2(2)=0.58$, $p=.75$).

We also compared Models with different measures of ToyPreferences to a reference model that only included ObjectType and Manner using the AIC. Only toddler's first touch predicted outcome imitation ($\Delta AIC=-3.1$, all other $\Delta AIC>2$), but not manner Imitation (all $\Delta AIC>2$).

We found no evidence that movement salience affects imitation and did not replicate higher imitation of hopping. Imitation depended on ObjectType: Cars attracted high imitation of sliding, suggesting a role of object knowledge and affordances in imitation. Finally, only toy preference measured by first touch predicted children’s subsequent outcome imitation.

A13 The infant and toddler curiosity questionnaire

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Curiosity is a seemingly intuitive concept and thought to be the driver of developmentally crucial factors such as exploration and learning. Yet, its emergence and mechanisms in infancy remain elusive. Here, we present our ongoing efforts of developing and evaluating the Infant and Toddler Curiosity Questionnaire (ITCQ) aimed to offer new insights in a reliable, valid and efficient way. 36 items were developed to capture individual differences in trait curiosity across the first two years of life. For this, we adopted a broad definition of infant curiosity as a keen desire or tendency to actively explore one's immediate surroundings. Accordingly, the items reflect how infants can actively explore and interact with their environment from birth onwards. Caregivers are asked to evaluate how well each item reflects their child's typical behavior on a Likert-scale from 1 ('strongly disagree') to 7 ('strongly agree') with an option of 'not applicable (NA)' for behaviors the child does not display (perhaps because they are too young). A pilot sample offered first indications of the scale's content validity, after which two studies were conducted to explore the scale's structural validity, test-retest reliability, as well as its association to other related constructs. A sample of currently N=321 (age: M = 13.87, SD = 5.54, range: 4.5-26.0, 52% female) UK caregiver responses, mostly recruited over Facebook, indicates high internal consistency (Cronbach's alpha = .88, Guttman's lambda = .91, Revelle's Omega = .88) and test-retest reliability after 7-14 days (N=31, Mage = 12.57, range: 5.5-24.21, 58% female, ICC = .89, $p < .001$). Preliminary exploratory factor analyses suggest a hierarchical structure, where three positively correlated sub-factors explain additional variance beyond a general factor. This structure will be further investigated on the preregistered final sample of N=360. We are also in the process of conducting a follow-up study relating the responses to this questionnaire to measures of infant temperament. With promising preliminary results, this measure will help disentangle sources of variance regarding, for instance, exploration patterns, language development and cognitive development (e.g., Slone et al., 2019; Muentener et al., 2018; Bornstein et al., 2013). It is thereby closing a crucial methodological gap in the field and will open new scientific avenues to better understand curiosity from infancy onward, but also its relation to other factors of early development.

A14 The Development of the Early Child Curiosity Questionnaire

Elena C. Altmann¹, Eline de Boer², Sarah Eiteljoerge³, Marina Bazhydai¹, Sabine Hunnius², Pinelopi Bounia-Mastrogianni⁴, Marlene Meyer², Didar Karadağ¹, Eleanor Braithwaite⁴, and Gert Westermann¹

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The population group with which one associates curiosity the most is children. To this day, however, only two caregiver reports have been developed to capture variability in children's curiosity (Piotrowski et al., 2014; Lee et al., 2023). Both are based on specific theoretical frameworks: the interest-deprivation theory (Litman & Jimerson, 2004) and the violation of expectation framework (e.g., Stahl & Feigenson, 2015). Here, we present a novel measure of general curiosity for children between the ages of 2 and 5 years, in which curiosity is captured more broadly where behavioral expressions were not constrained to any specific theoretical framework. The measure is based on the recently created Infant and Toddler Curiosity Questionnaire (ITCQ; Altmann et al., in prep), currently undergoing validation, which is applicable to infants up to 2 years of age. For the novel Early Child Curiosity Questionnaire (EECQ), we adapted and extended the item list to capture how this slightly older age group may explore their environment to learn about it. The new questionnaire consists of 41 items covering various exploratory behaviors such as "My child pokes at and probes objects to see how they feel (e.g., cotton balls, play dough, tree bark, etc.)" and "My child typically seeks clarification for things they do not understand (e.g., how something works)". Caregivers are asked to consider the last six months and rate each item on a 7-point Likert scale from 1 ('strongly disagree') to 7 ('strongly agree') as to how well it reflects their child's typical behavior. The measure is currently being piloted in the UK, Germany and the Netherlands; thus, we aim to present preliminary results of this international collaboration. The measure will be further developed, and its convergent and discriminant validity evaluated, establishing its internal and external validity for capturing individual differences in curiosity. As a result of this work, the newly developed EECQ will help us better understand the crucial developmental concept that is curiosity and enrich the methodological landscape of developmental research.

A15 The dance of social learning: investigating children's sampling behavior and learning performance in naturalistic interactions

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This study investigates the extent to which children's sampling behavior is influenced by others' sampling of information in naturalistic social interactions. The study uses a novel dual touch screen platform, which we term a Dyadic Interaction Platform for children (DIPc), which enables two agents to observe and interact with one another as they manipulate a shared visual space. Here, the child can not only actively select objects whose label they want to hear but also sees the objects the other agent, their caregiver, chose to hear the label of, and subsequently hears this label. We examine whether children elicit the labels of objects their partners chose to hear the label of, as well as their learning of these labels, both when they sampled the object or when their partner sampled the object. In particular, we ask (i) how often children co-opt their partners' sampling choices (ii) whether there is an active learning benefit in dynamic social interactions as has been shown in less socially embedded contexts and (iii) whether this active learning benefit is modulated by the contingency of the social interaction and children's attention to objects they sampled relative to objects their caregiver sampled. We record participants' tapping behavior, speech, and gaze behavior using two head-mounted eye trackers. Overall, this study will provide insights into children's active learning and sampling behavior in naturalistic social interactions and sheds light on the social basis of active learning. The use of the DIPc platform including mobile eye trackers allows for a more comprehensive and detailed analysis of children's behavior and learning in social interactions.

A16 Testing the developmental trajectory of statistical learning ability in toddlerhood

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Languages contain statistics relevant for word segmentation, such as transitional probabilities (TPs) across adjacent syllables. Infants and adults can track such patterns in speech (Saffran et al., 1997), but whether this ability changes during toddlerhood, a period of rapid lexical growth, remains unclear. Thus, we will ask whether 1) the ability to learn statistics that are consistent with the native language (NL) improves over this time; and 2) whether learning statistics which are inconsistent worsen as NL knowledge increases.

To address these questions, we will develop a nonword repetition task suitable for British-English speaking 2-4-year-olds. This age is especially relevant to understanding the role of SL in lexical development as SL ability predicts NL vocabulary size at 24 months (Frost et al., 2020). Children will repeat nonwords containing 2-5 syllables that contain relatively high-TPs (NL-Consistent), or low-TPs (NL-Inconsistent), based on calculations from child-directed British-English speech (ENG-UK corpora, CHILDES: MacWhinney, 2000). The nonwords will be repeated multiple times, and responses will be coded for length and accuracy. More complete and accurate repetition of a nonword reflects stronger sensitivity to its TPs.

To assess initial sensitivity to NL statistics we will compare performance on NL-Consistent vs NL-Inconsistent sequences at the start of the task. To assess the ability to learn novel statistics, we will assess changes in performance on NL-Consistent and NL-Inconsistent sequences which are repeatedly encountered. We expect all children to perform better on NL-Consistent sequences than NL-Inconsistent sequences at the start of testing, but that older children will show a greater NL advantage. We also expect older children to show greater improvements on NL-Consistent sequences than younger children, but younger children to improve more on NL-Inconsistent sequences. These results shed light on whether and how SL ability changes across development, and whether the ability to learn novel statistical sequences in speech is tuned across development by the statistics that a learner already knows.

A17 Revealing early learning skills during stimulus exposure: An EEG frequency tagging approach

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Visual statistical learning refers to the ability to detect and extract regularities from the environment. It allows preverbal infants to organise visual stimulation in a coherent representation. Thus far, statistical learning has been primarily investigated with post-exposure behavioural tasks that can only reveal the outcome of learning. Notably, behavioural tasks may lead to ambiguous interpretations since there is no clear consensus about the directionality of the expected learning outcome in infancy (i.e., novelty vs. familiarity effect). Electrophysiological measures such as steady-state visual evoked potentials (SSVEPs) can be acquired while learning occurs and can shed light onto the temporal course of learning. To date, similar investigations have been limited to the auditory domain (Choi et al., 2020). In this study, we propose an EEG frequency tagging approach to study infants' SSVEPs in response to visual regularities. Participants were 4- to 6-month-old infants born at term. They were presented with continuous streams of 8 colourful shapes appearing in the centre of the screen at a frequency of 6 Hz. Infants were randomly assigned to one of three conditions: 1) the standard doublet condition, in which shapes were organised in doublets, 2) the control doublet condition, in which only the first element of the pair followed a rule, and 3) the single condition, in which individual shapes were randomly presented. We compared SSVEPs at the frequency of visual stimulation (6 Hz and its higher harmonics) and at the doublet frequency (3 Hz and its higher harmonics) across conditions. If the stream of shapes included visual regularities, we hypothesised not only a strong steady-state response at the base frequency of 6 Hz but also a progressive response at 3 Hz. Results revealed neural entrainment at the base frequency of visual stimulation (6 Hz and its harmonics) that did not differ across experimental conditions. This confirms that infants were similarly attending to the visual stream of stimuli in all conditions. On the other side, activity at the doublet presentation frequency (3 Hz and its harmonics) varied across conditions. Infants assigned to the doublet conditions showed greater responses at the doublet frequency harmonics, especially at 9 Hz, compared to the single condition. Overall, these results suggest that the infant brain can detect visual regularities in a stream of shapes from very early on. These findings are crucial to better understand learning mechanisms during stimulus exposure.

A18 Dynamic attention in early infancy: The role of neural entrainment to visual rhythms

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Effective learning in infancy depends on the ability to selectively attend to informative stimuli. Research done with adults suggests that this ability is supported by brain oscillations selectively entraining to relevant external rhythms.

In our study with 6-month-olds ($n = 140$), we have investigated this phenomenon in the visual domain using electroencephalography (EEG). Specifically, we asked how adult gaze direction modulates infant attention and neural processing of stimuli presented rhythmically in the visual periphery.

6-month-olds were 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 turned her gaze to one of the two objects. There were 3 main types of trials: theta, with both peripheral objects flickering in the theta band, implicated in learning (3.5 & 4.5 Hz), alpha, with both objects flickering in the infant alpha band, associated with attention inhibition, (5.5 & 6.5 Hz) and mixed, with one object flickering in the theta and the other in the infant alpha frequency band (4.5 & 6.5 Hz).

As an index of neural entrainment, we used steady state visually evoked potentials (SSVEPs) to visual flicker. We hypothesized that, across trial types, SSVEP signal-to-noise ratios (i.e., power at the frequency of interest relative to the power at neighboring frequencies) will be stronger to the frequencies of objects congruent vs. incongruent with the stimulus gaze direction. Moreover, we hypothesized that this effect is more pronounced for theta when compared with alpha frequencies, speaking for a differential functionality of the two brain rhythms.

Data collection has been completed and the analyses are ongoing. We will present the results of these analyses addressing the hypotheses outlined above.

A19 The development of cortical adaptation from infancy to adulthood

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When we grow from being infants to children to adults, our cognitive abilities become reliant more on previous experience and less on current processing. Namely, we integrate more information from memory in every cognitive task that we perform. This wider integration spans contexts, space, time, and other dimensions. In this study, we investigate how the integration across time develops from infancy to adulthood using cortical adaptation as a marker for the timescale of integration from memory (Lu et al., 1992). Cortical adaptation has been characterized in various neuroimaging studies as a carrier of memory (Kobayashi et al., 2014; Weigelt et al., 2008). Additionally, atypical cortical adaptation and memory span was found related to cognitive disorders such as dyslexia and ASD in adults and infants (Lieder et al., 2019; Miron et al., 2016). While previous research has explored cortical adaptation in specific age groups, less is known about how it changes across development and the nature of the relationship between cortical and cognitive development is poorly understood. In this study, we investigate the development of cortical adaptation from infancy to adulthood. Using fNIRS and an identical task across the age groups we investigate how the temporal, occipital, and frontal cortices in the infant, child, and adult brain respond to repetition of audio-visual stimuli in varying inter-stimulus-intervals. We expect to find shorter adaptation timescales (faster recovery) in infancy and early childhood and longer timescales later towards adolescence and adulthood. Such a pattern of results will demonstrate how cortical adaptation can be used as a proxy for implicit memory capacity. It will facilitate tracking of the development of implicit memory aptitude and its divergence from typicality at every point during development.

A20 Listening to a story or creating one: Children performances and brain activity in scaffolding-based learning in the storytelling domain

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For young children, learning novel words and their functions is highly dependent on social engagement with adults and other children (Tomasello, 1992). This engagement can take form as “Active learning” – learning that requires learners to engage cognitively and meaningfully with the materials rather than just passively receiving it (Chi & Wylie, 2014). In this study, we investigate the potential benefits of combining two effective active learning strategies, scaffolding and storytelling. Scaffolding, characterized by constructive engagement behaviors that redirect learners’ actions and understanding, has been shown to promote bidirectional exchange between instructors and learners (Pan et al., 2020). On the other hand, storytelling has been found to improve language acquisition (Miller & Pennycuff, 2008 ; Speaker et al., 2004), reading comprehension (Craig et al., 2001, Rahiem, 2021), and understanding of basic mathematics and science (Casey et al., 2008; Hu et al., 2020; Pramling & Samuelsson, 2008; Walan, 2019). Each strategy has been researched in the behavioral aspect, and recent works begun to characterize its associated neural activity (Hasson et al., 2012; Nguyen et al., 2022; Pan et al., 2020; Piazza et al., 2021). However, the potential benefits of combining scaffolding and storytelling and the underlying neuronal mechanism of this combination, remain unknown. In this study, we aim to explore the efficacy and neural activity associated with a scaffolding approach in the context of storytelling. Our goal is to advance the understanding of how to these two strategies interact in combination and impact educational outcomes. Specifically, we hypothesize that scaffolding-storytelling-based learning, which involves engaging children to tell stories based on the learning-subject, would facilitate better learning outcomes than explanation-storytelling-based learning, which entails instructors telling stories to the child. Additionally, we hypothesize that the level of inter-subject correlation of the children's brain activity will be positively correlated with their performance, and that scaffolding-storytelling-based learning will promote greater instructor-learner brain coupling compared to explanation-storytelling-based learning. Using fNIRS, we recorded the neural activity of 25 instructor-child dyads and measured 52 channels located on the frontal, temporal and parietal lobes. Preliminary results will be presented at the conference.

A21 Neural entrainment as a measure of speech segmentation

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Before infants can learn what words mean, they need to break down the continuous stream of sounds they hear in speech into individual words. While existing measures of speech segmentation are informative at a group level (e.g. determining what 8-month-old infants as a group can do), concerns have been raised about their suitability to capture individual differences (Aslin, 2007; Pérez-Edgar et al., 2020). As an alternative, researchers have begun to look at neural entrainment (NE), recorded by electroencephalogram (EEG), to measure speech segmentation while infants discover word boundaries in real-time (Choi et al., 2020; Kabdebon et al., 2015, 2022). The current study aims to determine whether infants' neural entrainment (at the word rate) is a robust measure of speech segmentation. More specifically, it measures the test-retest reliability of NE as well as compares NE to ERPs and a concurrent CDI measure. Eight-month-old infants complete 2 testing sessions 5-7 days apart. At each visit, they complete two experiments that test different cues to word boundaries: transitional probability (TP) and syllabic stress pattern. For each experiment, participants listen to a continuous stream of an artificial language for approximately 3.5 minutes followed by 32 test trials in which words and part-words are presented in isolation. NE is calculated from EEG data collected during the familiarisation phase while ERP analysis is performed on the test phase data. Results will demonstrate whether NE is a reliable measure of segmentation skills. Preliminary results will be presented at the conference.

**A22 How do infants' and parents' gestures influence later language development?
The roles of informative and expressive pointing**

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Gesture emerges early in development, yet little is known about how pointing at the level of communicative intent relates to later language competence (Iverson & Goldin-Meadow, 2005). Research suggests that parental declarative pointing links with infants' own pointing production and later language development (Choi et al., 2021; Matthews et al., 2012; Rowe, 2000). However, only a small amount of research has considered the finer details of whether infants are exposed to different types of ostensive and declarative gestures (e.g., showing, giving, informative & expressive), how the level of support provided by parents varies by gestural type and how these may be associated with infants' own pointing and later language understanding. This study of 50 infant-parent dyads in interaction aims to clarify the role that parental pointing plays in supporting development. It analyses how different types of gesture occur in spontaneous interaction with toys provided to elicit such referencing.

Infant-parent dyads participated when the former were 10-12 months old and again when they were 14-16 months. In each session they were recorded in 15-minute unstructured free-play sessions. At each of these stages we measured receptive and expressive vocabulary, (using the Mullen Scale of Early Learning) and three months after the second session assessed the toddler's language development (using the UK-CDI). Video data were coded for parental and infant gesture. We seek to find how different parental gestures relate to infant gestures within and across sessions. We explore whether the types of infant- and parent-gestures influence infants' subsequent language development.

Early analysis suggests that parents tend to use more ostensive showing gestures and highly supportive expressive pointing gestures in comparison to other forms of points and ostensive giving actions. These together suggest that during spontaneous interaction, parents bring their world to the infant and adapt their gestural repertoire to the infant's abilities.

A23 Season-of-birth affects infant expressive language – But only when their mothers did not take vitamin supplementation during pregnancy

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At LCICD last year, Muñoz, Kartushina and Mayor (2022) reported that season-of-birth effects modulate vocabulary sizes of 12-month-olds, infants born in the fall outperforming those born in early summer; a result potentially pointing towards the psychopathology hypothesis that prenatal aggressions on the foetal central nervous system are more susceptible to happen during winter (e.g., viruses, vitamin D deficiency).

In the present study we investigate whether maternal vitamin supplementation, which protects against vitamin D deficiency and viral aggressions in expecting mothers, further influences associations between season-of-birth and language and cognitive skills. We analysed data from the Little in Norway cohort ($n=816$), which included information on vitamin supplementation during pregnancy, vitamin D levels in expecting mothers, and language and cognitive skills of infants, measured by the Bayley test. Furthermore, geographical location of participating families (Northern, Central, Southern Norway) allowed to further evaluate whether latitude of residence acts as a risk factor for lower scores since it coincides with reduced sun exposure during winter, potentially translating into lower vitamin D levels during pregnancy.

In a first set of preregistered models, we evaluated whether season-of-birth effects were present on language and cognitive scores of infants at 6, 12 and 18 months of age, in interaction with latitude and the child's age. Date of birth was transformed into radians to account for cyclicity of seasons over the year. We adopted a full-null comparison, controlling for maternal education and number of siblings in the null. For cognitive scores, we found a significant main effect of season-of-birth ($p=.019$) and an interaction age:latitude ($p=.005$). For language scores, we found significant effects of latitude, only.

Yet, in a second set of preregistered models, we evaluated whether vitamin supplementation during pregnancy improved model fits. While cognitive scores and receptive language saw no further improvements, history of vitamin supplementation improved the model for expressive language ($p=.010$), with two significant 3-way interactions; age:Latitude:supplement ($p=.020$), and season_of_birth:latitude:supplement ($p=0.38$). Post-hoc analyses showed that the amplitude of season-of-birth was significantly reduced when mothers took prenatal

supplements. Exploratory analyses linking maternal vitamin D levels, on a much-reduced set of participants, and infant scores were inconclusive.

In sum, we provide evidence suggesting that the lack of maternal vitamin supplementation during pregnancy translates into season-of-birth effects on infant expressive language, potentially via reduced protection against vitamin D deficiency and viral aggressions to the development of the foetus CNS system during winter months.

A24 How do different joint attention types help 12- to 16-month-old children learn new words?

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The episode of joint attention is thought to promote child lexical acquisition (Akhtar, 2005; Baldwin, 1993; Mundy et al., 2007; Scaife & Bruner, 1975; Tomasello & Farrar, 1986; Tomasello & Todd, 1983). Children's engagement in joint attention requires them to coordinate attention with partner ('partner' refers to interactant, e.g., parent or experimenter) onto a third entity (Tomasello & Farrar, 1986). The attention of people who get involved can be shared, followed-into, and directed (Carpenter et al., 1998). To share attention, children may initiate or respond to joint attentional bids (*RJA*) (Mundy et al., 2007; Mundy et al., 2003). Partners might direct or follow into children's attention (Tomasello & Todd, 1983; Tomasello & Farrar, 1986). It seems controversial when comparing the results. Children's performance in *RJA* displays a consistently positive prediction on subsequent language abilities (Mundy et al., 2007), whereas partner's directiveness is not correlated or negatively correlated with children's vocabulary size (Tomasello & Farrar, 1986). It may not be the case if considering variability of children's performance in *RJA*.

The current study compares the effect of three ways in which children get involved in joint attention on word learning. We established three semi-natural interactive conditions, i.e., follow, share, and direct, each with two to three trials. In a trial, a child plays a toy set with an experimenter. The experimenter provides a pseudoword when child is 1) looking at, 2) sharing, or 3) directed to a target. Word comprehension is tested right after. Children's performance is video-taped and coded. We would work with 72 12- to 16-month-old children. Our piloting has validated feasibility of method.

Our first hypothesis: *children's performance in word learning task may vary across three conditions*. Children can learn words significantly more while their attention is being followed into than directed away by an interactant when pseudowords are present. We also want to compare child and parent initiations: *Do follow and share initiation types differentially impact on children's pseudoword learning?*

Further, if children learned less words in direct condition, we would investigate a second hypothesis: *word learning might be impacted upon whether child follows experimenter's direction*. Across trials, if children successfully look at the target when they are directed to, they may learn words better than when they do not look.

We would test all participants by the end of academic year. We would establish logistic (binomial) mixed effect models to compare word comprehension across conditions.

A25 Investigating the variability of infant-directed speech: Researcher-IDS and early language studies

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Infant-directed speech (IDS) is the register that many parents and caregivers use when interacting with infants and many studies have shown that infants demonstrate a preference for IDS over adult-directed speech (ADS). Due to this preference many developmental researchers use IDS as the preferred register in their speech perception and word learning studies.

The acoustic and prosodic characteristics of IDS are well-documented and include: slower tempo, longer pauses, shorter sentences, hyper-articulation of vowels, heightened and varied pitch, and increased positive affect. Several studies have found that IDS facilitates early language acquisition in infants prior to 12 months, facilitating native vowel and consonant discrimination, word segmentation, word recognition, and phoneme categorisation. In older infants, it has been shown to facilitate early word-learning, with 17- and 21-month-olds able to learn in IDS but unable to do so in ADS.

However, the IDS that is used in these studies varies in both how it is produced and measured. When recording IDS stimuli for use in infant research, methods vary considerably. While a number of studies use recordings of mothers (and/or fathers) producing natural speech while talking to their infant, others use a researcher, actor, or a parent who was not speaking to their child to record the stimuli. Given these differences, the current study investigates how what we term researcher-IDS differs from typical IDS, produced by a mother.

Methodology

Sixty Australian-English mother-infant dyads (M child age 16.79 mos) participated in a one-on-one play session to record mothers' natural IDS. Following this, the mothers participated in a short interview with a researcher to elicit ADS. A researcher familiar with IDS also recorded the same stimulus words used by mothers in IDS and ADS for comparison.

Results & Discussion

In order to measure the differences between IDS and ADS, and also how mothers' IDS differs from researcher-IDS, acoustic and statistical analyses were conducted. This

included measuring vowel duration, pitch (F0) and pitch range, formant frequencies (F1, F2, F3) and formant trajectories to determine how much variation and dynamic spectral change each register contains. The registers are also being measured for vowel hyper-articulation, to determine the size of the vowel space of mothers' ADS and IDS and how this compares to researcher-IDS. These findings and implications for the research will be presented at the conference.

A26 Form-function relationship in the amplitude and frequency modulations of infant-directed speech: A predictive processing perspective

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Infants prefer the speech register that caregivers tend to direct to them, infant-directed speech (IDS), over adult-directed speech (ADS) (Byers-Heinlein et al., 2021). IDS is thought to serve specific functions compared to ADS, attracting infant attention to the speech signal while conveying clear opportunities for easier word segmentation (Kalashnikova et al., 2018). However, the acoustic properties that differentiate IDS from ADS have rarely been investigated from an information theory perspective. Infants are powerful predictive agents (Köster et al., 2020), orienting their attention towards stimuli that maximise learning potential (Kidd et al., 2014; Poli et al., 2020). Caregivers may choose to modulate the complexity of their IDS to achieve optimal stimulation, using opposing forces: unpredictability, to grab attention by inducing uncertainty (Räsänen et al., 2018; Meyer et al., 2023; Peters et al., 2017); and predictability, to maintain attention by increasing interpersonal coordination (Vesper et al., 2011; Woźniak, 2022; Lense et al., 2022). Literature on the functionalities of IDS acoustics seems to point towards diverging strategies of different features. On one hand, IDS pitch (F0) is often reported as more variable (Cooke et al., 2014), i.e., less predictable by our metric and, therefore, more attention-grabbing than ADS pitch. On the other hand, IDS exhibits more predictable amplitude modulations than ADS (Leong et al., 2014), which supports enhanced neural entrainment, interpersonal synchrony, and word segmentation.

First, we hypothesised that due to their different functions, IDS and ADS should be clustered apart on the frequency-envelope-predictability plane. Second, we hypothesised that the IDS envelope would be more predictable than the ADS envelope; and that the frequency in IDS would be less predictable than in ADS.

We longitudinally recorded naturalistic IDS and ADS during interactions ($n=100$) with 5-, 10-, and 15-month-olds and computed each vocalisation's frequency and envelope predictability. We estimated frequency predictability using the entropy of the F0 distribution (Shannon, 1948). We measured envelope predictability using the Long-Short-Term-Memory predictive error of the amplitude envelope. Preliminary results ($n_{\text{vocalisations}}=73$) showed that IDS and ADS are clustered ($t(71) = 6.44, p < .001$) and respectively positioned in the frequency-envelope-predictability plane, with IDS envelopes being more predictable than ADS envelopes ($t(71) = -6.48, p < .001$) but

IDS frequencies being less predictable than ADS ($t(71) = 4.38, p < .001$), confirming our hypotheses.

Thus, we think that caregivers use the predictability of speech features in diverging but complementary ways to both attract and maintain infants' attention.

A27 Mothers' and fathers' infant-directed speech have similar acoustic properties, but these are not associated with direct or indirect measures of word comprehension in 8-month-old infants

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Parents modify their speech when talking to infants: They slow down, heighten and vary their pitch, lengthen vowels, and expand their vowel space area. This 'infant-directed speech' (IDS) has been suggested to make speech more attractive (ManyBabies Consortium, 2020) and to facilitate language learning (Golinkoff et al., 2015). Yet, an unquestionable focus on mothers' over fathers' speech (Ferjan Ramírez, 2022), and inconsistent results on the role of IDS in language development (Suttora et al., 2017) call for a thorough examination of the acoustic properties of IDS, in both parents, and their potential impact on infants' language outcomes when using direct (eye-tracking) and indirect (parent report) measures.

Forty-five parent-infant dyads living in Oslo, Norway, participated in the current pre-registered study. Parents (24 mothers, 21 fathers) were native speakers of Norwegian, and infants (21 girls, 24 boys, mean age 8.2m) were born full-term. In the lab, parents were recorded reading a picture-book to their infant (IDS) and to an experimenter (ADS), and infants took part in an intermodal preferential looking eye-tracking task to assess word comprehension. Additionally, parents reported their infants' receptive vocabulary using the Norwegian CDIs.

Mixed-effect models revealed that parents' IDS, as compared to ADS, were characterised by higher pitch, wider pitch range, more abrupt pitch change, slower articulation rate, longer vowel duration, increased vowel space expansion, and more variable and less distinct vowel categories (p 's < .001). Results held for both mothers and fathers, but mothers' effect-sizes tended to be larger (Hedges g 's ranges: 0.55-1.38) than fathers' (0.41-1.09). Using a full-null model approach to minimize type I-errors, we found no evidence that any acoustic features of parents' speech were associated with direct or indirect measures of infants' word comprehension (p 's > .05).

These results echo previous findings on IDS reported in other languages (Cox et al., 2022), and on Norwegian IDS to older toddlers (Rosslund et al., 2022), but are here extended to fathers' speech; both genders' IDS had exaggerated prosody and expanded vowel spaces, and more variable and less distinct vowels. Hence, while IDS might function as a 'perceptual hook', more variable vowels suggest that it may not provide a cleaner acoustic input to the child. We found no evidence that features of parents' speech were associated with infants' word comprehension, suggesting that a

potential facilitating role of IDS may appear later in development when word comprehension is more robust, and/or be related to other pre-linguistic skills.

A28 Characterizing affective messages in infant directed speech

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The face-to-face interactions that occur between infants and their caregivers are unique and impact infant development across multiple domains, such as emotion regulation, sensory, motor and cognitive development, speech processing and vocal development (Brazelton et al 1975). In the expressive modality, facial expressions of basic emotion are associated with specific movement configurations which can be coded using the Facial Affect Coding System (FACS). In the literature, one study has adopted an infant-oriented approach to illuminate the early affective experience of young infants. Using static images, Chong et al. (2003) identified three facial expressions (comfort, interest and happiness) that mothers used when interacting with their infants. Taking this approach, but using a new tool for automated FACS analysis, it is possible to define the unique manner that emotion and affective-motivational cues are shared during IDS, a step towards understanding how infants process meaningful affective messages and how this shapes their development more broadly.

The current project aims to advance and establish a platform for ongoing work on infant affective processing motivated by an infant communication perspective. To accomplish this goal, the proposed research will: 1) create a bank of audio-video recordings of adults engaged in face-to-face interaction with an infant in which different types of affective messages are communicated; and 2) identify facial movement templates that are reliable and convey distinct affective meanings during infant-directed speech (IDS). To achieve objective 1, 32 English and French-speaking parents will be video recorded when interacting with their infant (4-7 months) using the same protocol as Chong. Parents will also complete a Self-Assessment Manikin to acquire a brief, non-verbal measure of their subjective feelings on each topic during the interaction. To accomplish objective 2, segments from video recordings will be selected and subjective (perceptual assessments by judges) and objective (create FACS templates with FaceReader software) analysis will be done. These findings will provide a replication and extension of the patterns reported in Chong et al (2003) using dynamic stimuli. We expect to observe IDS affective messages with unique perceptual features that do not fully match the facial expressions adults use when talking to adults.

A29 Maternal beliefs and care practises on manual goal-directed behaviourPriscilla Ferronato^{1,2}, Renata de Felipe³, Barbara Bezerra¹, and Karina Demichei¹¹Paulista University, São Paulo, Brazil, ²McGill University, Montreal, Canada,³University of São Paulo, São Paulo, Brazil

Beliefs about development impact the way infants are cared for and stimulated, especially during the first year of life. During this period, the opportunities which infants are exposed depend directly on what the adult offers to them (Valsiner, 1997). The current study aimed to investigate 1) whether maternal characteristics could predict beliefs on infants' manual goal-directed behaviour, and 2) whether maternal beliefs on infants' manual goal-directed behaviour could be related to care stimulation practises implemented during infants' first year. Seventy-two mothers answered the same questionnaire at two different moments (when infant was up to 3 months old and between 6 to 9 months old). The questions were about sociodemographic status, gestational information, infants' characteristics at birth, and stimulation practises as posture positioning and hands stimulation. To attend the objective 1 a binary logistic regression was run. The results showed that the higher number of children in the household, the higher the chance of the mothers consider infants' manual behaviour as goal-directed ($p=0,03$). Moreover, the higher infants' age, the higher the chance of the mothers consider infants' manual behaviour as goal-directed ($p=0,03$). These results indicate that the more experience mothers have on infants' care, the more infant's behaviour are perceived as goal-directed. Regarding mother's beliefs and care and stimulation practises, the qui square analysis showed an association between the mothers' beliefs on manual goal-directed behaviour and toy's offer practises, both at 3 months old ($p=0,05$) and at 9 months old ($p<0,001$). These results show that mothers who believe that their infants present goal-direct behaviour tend to provide them more manual stimuli. Regarding posture positioning, mothers mostly positioned their infants in the lap at 3 months old, however, at 9 months old infants are mostly positioned on the floor. No statistical significance was found between mothers' beliefs on manual goal-directed behaviour and posture positioning at both age moments. As a conclusion, the results show that mothers' characteristics and believes influence infant care practises. These findings are an important indicative that mothers and infants can benefit from information about the active behaviour development during the first months after birth.

A30 Parenting practices and temperament impacting child behavior problems

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Mothers' emotional and behavioral regulation skills are a key component in parenting practices (Altafim et al., 2018) that help control impulsive and coercive maternal behaviors (Sanders et al., 2019). Self-regulation is an important component of temperament that contributes to the process of regulating emotions and behavior. Specifically, effortful control is related to the ability to focus and divert attention when desired, plan future actions, and suppress inappropriate responses, which are closely associated with the ability to self-regulate (Evans & Rothbart, 2007; Rothbart, 2007). Additionally, parenting influences children's emotional regulation and behavior (Goagoses et al., 2022). The aim of the present study was to examine the associations between parenting practices and maternal temperament to explain behavior problems in children. The sample included 40 mothers of 2-to-4-year-old children. The mothers were interviewed using the ACT Scale (Silva, 2011; Brazilian version of Altafim et al., 2018), to evaluate parenting practices (positive discipline, communication, and emotional and behavioral regulation), Adult Temperament Questionnaire (ATQ; Evans & Rothbart, 2007; Brazilian version Linhares, Gracioli, Klein, & Almeida, 2012) to assess mothers' temperament (negative affect, effortful control, extroversion and sensitivity to guidance), and Strengths and Difficulties Questionnaire (SDQ; Fleitlich, Córdazar, & Goodman, 2000; Goodman, 1997) to evaluate children's total, externalizing and internalizing behavior problems. Descriptive, correlation, and multiple linear regression statistical analyzes were performed, accepting the variance inflation factor $VIF < 2$. The significance level for all tests was $p \leq 0.05$. The results showed that maternal parenting practice with less positive discipline and maternal temperament with less effortful control explained 43% of the total behavior problems of children ($p < 0.0001$). The externalizing problems were explained in 38% by less communication in parenting practices and extraversion in maternal temperament, and child male gender ($p < 0.0001$). The internalizing problem, in turn, was explained in 36% by less emotional and behavior regulation in parenting practices and effortful control, and more extraversion ($p < 0.0001$). In conclusion, negative parenting practices associated with difficulties in maternal effortful control contributed to explaining behavior problems in early childhood. The findings have implications for parenting programs, suggesting investment in both strengthening positive parenting practices and maternal emotional and behavioral regulation, aiming to prevent children's behavior problems.

A31 Mothers' pre-mentalization mediates the relationship between parenting stress and children's emotion regulation difficulties

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Emotion regulation skills during early childhood years are crucial for social and academic development throughout the lifespan (Feng, 2008). It is known that the development of children's emotion regulation skills depends mostly on their parents (Morris et al., 2007). Limited research shows that parental reflective functioning, defined as the parent's capacity to reflect upon their children's mental states (Luyten et al., 2009), is related to emotion regulation development (Álvarez et al., 2022). Parental reflective functioning can be distorted due to parenting stress, as shown by negative associations between these variables (Nijssens et al., 2018). This study tested whether parental reflective functioning mediates the relationship between parenting stress and children's emotion regulation skills. We expected higher levels of parenting stress to be negatively associated with parental reflective functioning and parental reflective functioning to be negatively associated with emotion regulation difficulties.

We collected data from 45 mothers of young children (23 girls, age range=25-59 months, $M(SD)=39.9(8.7)$). As an index of children's emotion regulation difficulties, we used the lability-negativity (e.g., anger dysregulation) subscale of the Emotion Regulation Checklist (Shields & Cicchetti, 1997). With the Parental Reflective Functioning Questionnaire (Luyten et al., 2009), we measured mothers' pre-mentalization (e.g., making malicious attributions about mental states), certainty about their children's mental states (e.g., thinking that their own thoughts about the child's mental states are accurate), and their interest and curiosity in their children's mental states. Additionally, mothers completed the Parenting Stress Scale (Özmen & Özmen, 2012).

As expected, children with higher lability-negativity scores had mothers with higher parenting stress ($r=.30, p=.03$) and pre-mentalization scores ($r=.45, p=.002$). The mediation model with pre-mentalization as the mediator was significant ($F(3,41)=3.81, R^2=.22, p=.017$) and showed that parental pre-mentalization mediated the relation between parenting stress and children's emotion regulation difficulties (standardized indirect effect coefficient=.12, $SE=.06, 95\% \text{BCA-}CI=.02-.28$). On the other hand, mothers' certainty about and their interest and curiosity in their children's mental states were not significant mediators.

Our findings suggest that mothers' inability to accurately reflect on their children's mental states, especially their tendency to make malicious attributions about

children's behaviors and intentions can lead to problems in children's emotion regulation skills. These cross-sectional findings call for a longitudinal investigation and suggest that parenting stress and their pre-mentalization tendency may be targeted in prevention and intervention programs to support children's emotion regulation skills.

A32 Mothers' supportive and non-supportive responses to children's negative emotions and children's emotion regulation skills

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Early years of life play a significant role in developing emotion regulation skills (Cole, 2009). Parents' supportive and non-supportive reactions to their children's negative emotions have been linked to emotion regulation development (Nelson et al., 2009). Most studies that explored this relation relied on self-report measures, which are subject to response biases and may not truly reflect the behaviors parents would employ in naturalistic settings (McMahon & Naragon-Gainey, 2020). The present study uses both an observational setting and parental self-report and investigates (1) whether there is an association between observed and self-reported maternal reactions to children's negative emotions and (2) the relationship between mothers' reactions and children's emotion regulation skills.

We collected data from 48 mothers of 2- to 4-year-old children (24 girls, age range=25-59 months, $M(SD)=40.4(8.7)$). Negative emotion was elicited from children with the Disappointing Gift Paradigm, where children's response to an undesired gift was observed (Cole, 1986). Mothers' supportive and non-supportive reactions were coded during the two minutes following the presentation of the disappointing gift to children. Mothers' supportive and non-supportive reactions were further assessed with the Coping with Children's Negative Emotions Scale (Fabes et al., 1990). Finally, children's emotion regulation skills were measured by asking mothers to complete the Emotion Regulation Checklist (Shields & Cicchetti, 1997).

Mothers' observed ($M(SD)=3.21(1.74)$, range=0-7) and self-reported ($M(SD)=4.27(0.40)$, range=3.3-5) supportive reactions were positively correlated ($r_s=.31$, $p=.039$). This relationship was not significant for mothers' observed ($M(SD)=.40(.32)$, range=0-2), and self-reported ($M(SD)=1.72(.32)$, range=1.22-2.57) non-supportive reactions ($r_s=-.09$, $p=.53$). Furthermore, we found that mothers' self-reported supportive reactions were positively associated with children's emotion regulation skills ($M(SD)=3.22(0.37)$, range=2.38-4) ($r_s=.43$, $p=.003$). Furthermore, mothers' self-reported non-supportive reactions were positively associated with children's emotion regulation difficulties ($M(SD)=2.05(0.35)$, range=1.18-2.91) ($r_s=.30$, $p=.042$). Mothers' observed reactions were not related to children's emotion regulation skills.

The absence of significant associations between observed and self-reported non-supportive reactions may be due to mothers displaying fewer negative reactions in the laboratory because of being more mindful of their behaviors. Mothers' self-

reported, but not observed reactions were associated with children's emotion regulation skills suggesting that mothers' situation-specific and short-term reactions were insufficient to establish a significant association. We recommend adopting both observational and self-report measures in future studies due to each provides unique information.

A33 Patterns of Nurturing Care and the Status of the Ghanaian ChildKwame Sakyi^{1,2} and Prince Owusu^{2,3}*¹Oakland University, Rochester, USA, ²Center for Learning and Childhood Development-Ghana, Accra, Ghana, ³Michigan State University, East Lansing, USA*

Though recent evidence from neuroscientific studies link nurturing care to brain development and function through the life course, predictors of the framework are yet to be explored in Ghana and other African countries. This paper describes the patterns of nurturing care among caregivers of children aged 36 – 59 months in Ghana. It provides a baseline coverage of nurturing care and its associated factors in Ghana. Data for this study was sourced from the 2011 Multiple Indicator Cluster Survey, a nationally representative data. Children between the ages of 36-59 months were sampled and the sample size was 1,010. Bivariate as well as multivariate linear regression analysis were conducted to test association between socio-demographic characteristics: sex, region, maternal level of education, head of family's level of education, wealth quintile, number of children in the household on nurturing care. The results indicate that the level of nurturing care in Ghana appeared to vary by region, level of maternal education, household head's education, and wealth quintile. The results also suggest that level of nurturing care does not vary by gender or by child's sex. While nurturing care score declined with each additional child (2-14) in the household, the trend did not persist when maternal level of education and wealth are accounted for. To ensure improvement in nurturing care for all children in Ghana, regardless of their region or socio demographic characteristics, there is the need for structural level interventions to increase maternal education, education of heads of households, and poverty eradication.

A34 The role of early life language experiences in the transmission of family background inequality

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Children from families with fewer socioeconomic resources are at greater risk of poor long-term cognitive, educational, and literacy outcomes than children from better-off families. Children's early life language experiences are a key pathway for transmitting this family background inequality. Parents of lower socioeconomic status (SES) tend to employ less sophisticated vocabulary and use simpler syntactic structures than parents of higher SES. Thus, family SES is systematically associated with characteristics of the home language environment (i.e., parents' quantity and quality of speech). The link between SES and language environments is likely to drive the 'language gap' in speech and language ability that is evident between high SES and low SES infants from as early as 18 months of age. This SES-related 'language gap' persists and magnifies throughout development, affecting children's cognitive, educational, and literacy outcomes.

Previous studies in this area often relied on proxy measures to capture children's early life language experiences, such as lab-based observations of child-mother interactions. Overcoming this limitation, we extracted children's early life language environments from naturalistic samples of their mother's speech in E-Risk, a UK population-representative longitudinal cohort study of 1,116 families with children born in 1994 - 1995 in England and Wales. We focused on mothers' lexicon quality (i.e., lexical diversity score and the number of rare words used) and grammar (i.e., mean length of utterance and clausal diversity) to address three primary research questions.

1. To what extent does family SES predict children's early life language environments, as indexed by the mother's speech?
2. Do children's early life language environments predict their later cognitive, educational, and literacy outcomes throughout childhood and adolescence?
3. To what extent are associations between family SES and children's cognitive, educational, and literacy outcomes mediated by early life language environments?

Our pre-registered analyses include hierarchical regression models, latent growth curve models, and mediation models. Our findings will estimate the effect size of the influence that early life language experiences have on children's cognitive, educational, and literacy development. These early life language environments are experienced throughout infancy before a child has entered compulsory education.

Therefore, they are a useful target for intervention. The effect size from our results will be crucial in determining the potential effectiveness of early life language interventions for reducing family background inequality in child development.

A35 Effects of ACT-Raising Safe Kids Program to promote positive parenting in mothers at adolescence

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Introduction: The ACT-Raising Safe Kids (Silva, 2011; American Psychological Association) is an evidence-based intervention for the universal prevention of violence against children, focusing on strengthening positive parenting skills. The ACT Program was adapted for Brazil (Pedro et al., 2017; Altafim et al., 2016) and demonstrated evidence of effectiveness in adult mothers' samples (Altafim & Linhares, 2019). Objective: Examine the effects of the ACT Program on parenting practices, sense of parental competence, and child behavior in adolescents and young mothers at adolescence. Method: The sample comprised 40 low-income adolescents and young mothers (who became pregnant at adolescence) of 2-to-4-year-old children. The mothers were recruited in the State of Ceará (Northeast, Brazil). Recruitment and data collection were carried out mainly in Social Assistance Reference Centers. Mothers participated in the ACT program in 8-session groups, conducted by social workers certified as ACT facilitators. In a pre-intervention session, mothers answered the following scales: ACT, and Parenting and Family Adjustment Scale (PAFAS) to assess parenting practices, the Parental Sense of Competence scale (PSOC) to evaluate parenting sense of competence, and the Strengths and Difficulties Questionnaire (SDQ) to evaluate child behaviors. The Brazilian Economic Classification Criteria and Socio-demographic questionnaires were applied. The ACT, PAFAS, PSOC, and SDQ were also applied in the post-intervention session. An ACT-Ceará App was used to record the data and export data in spreadsheets. The within-group comparisons were done (paired t-test; $p < 0,05$). Results showed a statistically significant reduction in coercive practices (pre-intervention, mean = 3.55 2.17; post-intervention, mean = 2.70 2.15; $p < 0.02$). Regarding the children's behavior, there was a significant decrease in the total of difficulties (pre-intervention, mean = 13.98 \pm 6.04; post-intervention, mean = 11.60 \pm 6.13]; $p < 0.008$), and externalizing behavior (pre-intervention, mean = 7.38 \pm 3.68; post-intervention, mean = 6.28 \pm 3.41; $p < 0.03$). The parental sense of competence, positive discipline, emotional and behavioral regulation, and the child's prosocial behavior showed high scores in the pre-intervention (ceiling-effect). The ACT Program demonstrated positive effects to reduce negative parental practices in adolescent and young mothers, and child externalizing behaviors of their 2-to-4-year-old children.

A36 “Perhaps the frog has gone to the lake”: Mothers’ mental state talk about certainty mediates the relationship between mothers’ and children’s theory of mind

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Theory of mind (ToM) is a critical skill for children’s social, emotional, and academic outcomes (Astington & Pelletier, 2005). Infants who hear more mental state talk (MST) from their parents perform better on subsequent ToM tasks (Meins et al., 2002; Symons et al., 2006). Despite large variation in parental MST, the reasons behind these individual differences are understudied. We suggest that parents with better ToM skills may engage more comfortably in MST with their children, which could indirectly enhance their children’s ToM. Only two studies have examined the relationship between parents’ and children’s ToM and found a positive association (Devine & Hughes, 2019; Sabbagh & Seamans, 2008). The present study is the first to investigate the mediator role of maternal MST between mothers’ and children’s ToM.

Data were collected from 89 mother-child dyads (49 girls, *age range*=48-69 months, $M(SD) = 57(5.49)$) via videoconferencing. Mothers’ ToM was measured through the Reading the Mind in the Eyes Test (Baron-Cohen et al., 2001). Children completed the five-item ToM scale (Wellman & Liu, 2004). Mothers’ MST directed to their children was assessed by a story narration of the wordless picture book, "Frog, where are you?" (Mayer, 1969). Mothers’ MST in different categories (i.e., perception, physiological states, desire, motivation, affect, cognition) were coded based on the transcriptions of the story narrations with the coding scheme of Ilgaz et al. (in prep.).

Results demonstrated that only mothers’ MST about cognition, specifically *certainty* (e.g., “perhaps”, “definitely”) significantly mediated the relationship between mothers’ and children’s ToM ($F(2,78)=3.24, p=.04, R^2=.08$). Mothers who had higher ToM scores used more certainty terms ($\beta=.52, SE=.21, t(79)=2.46, p=.016$), which were related to higher ToM scores in children ($\beta=.04, SE=.02, t(78)=2.24, p=.028$) (*standardized indirect effect coefficient*=.07, $SE=.04, 95\% \text{BCA-}CI=.001-.161$).

These novel findings demonstrate that mothers who have a better understanding of mental states direct more MST about certainty to their children, enabling their children to better understand their own and others’ minds. Mothers’ use of certainty terms when talking with their children may uniquely contribute to children’s ToM development by helping them to understand that a person’s mental states may not always represent reality. A longitudinal study conducted with infants is highly recommended to enlighten the path between parents’ ToM, their MST in different categories, and infants’ later ToM.

A37 Growing into parenting together: Similarities and differences in parenting practices among first-time parents

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Introduction: When parents function well as a team, it supports healthy child development. An important aspect of coparenting is the level of agreement between partners on parental attitudes, behaviors, and goals. Here we examine the factors that contribute to similarities and differences in the parenting behaviors of mothers and fathers within the same family. Furthermore, we also examined how accurately parents perceive and assess their partner in terms of their parenting practices.

Methods: We recruited 280 Swiss-German couples who were first-time parents, living together, and had an only child at 12, 24 or 36 months (+/- 3 months). Both mothers and fathers completed an online survey on parenting practices that included both a self-assessment and an assessment of their partner's parenting practices. In addition, demographic variables such as education level, age, etc., and relationship satisfaction were assessed.

Results: We ran an Actor-Partner Interdependence Model (APIM) for all four scales on parenting practices (positive parenting, responsible parenting, authoritarian parenting, inconsistent discipline). Overall, there was a high perceived level of agreement regarding parental attitudes and behaviors among both mothers and fathers. In a next step, Multigroup APIM analyses will be conducted.

Outlook: Data analysis will be completed in May 2023. We expect higher levels of parenting agreement among couples who share similar demographic backgrounds, have longer-lasting and more satisfying relationships, and among parents with younger children compared to older children.

A38 Preserved semantic memory but impaired associative memory in a six-year-old child with developmental amnesia.

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We present the youngest patient to be diagnosed with developmental amnesia (DA) at age six. MRI scans revealed 48% bilateral hippocampal atrophy. A neuropsychological assessment showed age-appropriate vocabulary and semantic knowledge. Declarative memory was assessed with an experimental paradigm developed for preschool children called the “Birthday Party Game”. The game is an online app played on touchscreen tablet or phone. During encoding, participants are asked to help four characters get ready for a birthday party by affixing a hat, a pair of shoes, a snack and a toy to each character. After a delay (in which participants watch the events of the party) two memory tests are administered. During the associative memory test, participants help each character to identify their belongings from familiar foils. In the recognition test, participants identify familiar items from novel lures. The patient’s data are compared to 54 control children aged 3-6 years. Control children scored above chance (25%) on the associative memory test (mean 70%, SD= 18%) and the recognition memory test (mean 86%, SD = 19%). The patient performed at chance in the associative test (25%) and was significantly impaired with a Crawford’s one-sample t-test ($p < 0.01$) but performed well at the recognition test (94%). The patient was also asked 18 semantic memory questions such as “What’s a healthy snack to have at a birthday party?” and the patient gave appropriate answers to each question. These data have implications for the development of memory systems following early hippocampal damage.

A39 Effects of developmental care in the neonatal intensive care unit on stress and self-regulation behaviors in preterm neonates

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The Neonatal Intensive Care Unit (NICU) could be a risk factor for child development due to the stressful procedures to which the preterm neonates are submitted (Cong et al., 2017; Linhares & Gaspardo, 2017). The behaviors of stress in the neonatal phase should be managed through environmental strategies of developmental care that support the biobehavioral regulation of the neonates to minimize the negative impacts of stress on their development outcomes (Silva et al., 2018; van Dokkum et al., 2021). The aim of the study was to examine the predictive effect of stressful procedures and developmental care strategies in the NICU environment on stress and self-regulation behaviors of preterm neonates. The sample included 62 preterm neonates (gestational age mean = 31 weeks [± 2]) at the first week of the postnatal period (mean = 3 days [± 3]), hospitalized in NICU. The stressful procedures of the NICU were recorded in the medical records and were assessed by the Neonatal Infant Stressor Scale (Newnham et al., 2009). The NICU developmental care strategies were assessed using an observation protocol of the core measures of protected sleep, pain and stress assessment and management, developmental activities of daily living, and family-centered care (Coughlin et al., 2009). The stress and self-regulation behaviors of preterm neonates were assessed using an observation protocol, considering the autonomic, motor, and behavioral state systems (Als et al., 1982; Als et al., 2005). The descriptive statistical analysis, correlation, and multiple linear regression analysis were performed, accepting the variance inflation factor (VIF) < 2 (SPSS, version 25.0). The level of significance of the study was $p \leq 0.05$. The results showed that more developmental care strategies in the NICU predicted an 8% variability of fewer total stress behaviors in preterm neonates ($p = 0.03$). In addition, 8% of the variability of more autonomic system self-regulation behaviors in preterm infants was explained by more developmental care strategies in NICU ($p = 0.03$). Moreover, specifically more pain and stress assessment and management strategies in the NICU predicted a 14% variability of more behavioral state system self-regulation behaviors in preterm infants ($p = 0.003$). The findings of the study showed that developmental care was a consistent environmental protection predictor of biobehavioral regulation in preterm neonates hospitalized in the NICU. The developmental care protocol in the NICU should be targeted especially preterm neonates aiming to neutralize the negative impact of stressful events on their early development.

A40 Neonatal pain and developmental outcomes in children born preterm: A systematic review

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Premature neonates are subjected to intensive care treatment, often involving numerous painful or stressful diagnostic and therapeutic procedures and uncomfortable interventions. The impact of the cumulative pain experience on early development can generate a "cascade negative effect" throughout the child's development. An analysis of the studies published in the last years would update this finding and improve the understanding of the recent directions in the literature and future challenges. This study aimed to perform a systematic review of empirical studies published between 2014 and 2022 that examined the associations between neonatal pain and the development of children born preterm. The literature search was performed using PubMed, PsycINFO, LILACS, SciELO, and Web of Science databases and included the following search strategy: (pain) AND (preterm) AND (development). The data were extracted according to predefined inclusion and exclusion criteria. Sixteen studies were analyzed. The developmental outcomes in early development have identified a reduction in brain volume and functionality, deficits in neurobehavioral, cognitive, and language development, and elevation of biochemical and behavioral indicators of stress and behavior problems. The later outcomes in the development assessment were found sensory processing problems in children of preschool age, reduction in brain volume and maturation, cognitive and visual-motor integration delay, increased behavioral reactivity to pain indicators, and behavioral problems in school-age children. The findings of this systematic review showed that neonatal pain experiences are significantly associated with negative impacts on the development outcomes during infancy, toddlerhood, preschool, and school-age in preterm children. Considering that early pain experiences affect the child's development, the clinical practice of the interdisciplinary health team needs to include protection mechanisms for vulnerable infants exposed to the environment of toxic stress in the NICU.

A41 Patterns of speech sounds after surgery: Investigating infants' production of syllables following full cleft palate restorative surgery

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A wealth of research on typical development illustrates that prelinguistic vocalisation supports the progression to first words and later speech development (Oller, 2000; McCune and Vihman, 2001; Ramsdell-Hudock et al., 2019; McGillion et al., 2017). In fact, the tendency for infants to babble seems universal, captured by some clinical populations. In the UK, 1 in 600 babies are born with cleft lip and/or palate (Shaw et al., 2019) and almost all these infants undergo full palatal repair by 12 months (Fell et al., 2022). However, despite successful surgery, up to half of infants with a cleft palate (CP) encounter persistent speech difficulties that hold through childhood and into adulthood, impacting speech intelligibility, e.g., misarticulations, nasalisation, absent/weakened pressure consonants (Kaiser et al., 2017, Sell et al., 2015; Bunton and Hoit, 2018, Sainsbury et al., 2019). What remains an open question, is whether any of these long-lasting difficulties are identifiable within prelinguistic vocal patterns.

One possibility about why infants with CP divert from the typical trajectory is within the composition of their canonical vocalisations. A few studies reveal no significant difference in the frequency of analysable productions (Chapman et al., 2001; Willadsen and Albrechtsen, 2005; Stout et al., 2011), capturing that the compositional components of syllables require more research. The only known study to consider this in depth is of Korean-speaking infants with CP (Ha and Oller, 2021) who exhibited fewer true canonical productions (e.g., vocalisations excluding glottals and glides), insight we do not yet have about English-speaking infants.

The current study examines early vocalisations from 20 English-speaking ~14-month-old infants after repair, from palatal ages (i.e., months following surgery) 0;3 to 0;7. Hour-long segments of audio data were extracted from when each infant was most vocal across day-long LENA recordings and then phonetically transcribed. The transcription process captures of consonant-like (closure) categories; broad vowel categories (front, centre, back); and the vocalic positions within syllables. I compare vocal patterns relating to syllable composition and consonant-vowel sequences, as well as production frequency, preference, and repertoire range. These elements lend themselves to an analysis of babble ratios, vocal motor schemes, and syllable sequences within and across infants. Mean babble level—a measure adopted by Scherer (2008) for infants with CP—is also used to narrow the distance between clinical and academic vocalisation measures. The preliminary findings elucidate

whether syllable production is where infants with CP seemingly diverge from the typical trajectory.

A42 Children with mild-to-moderate hearing loss across the UK: The under 5s

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Successful communication is critical for children's education and social development (Misurelli et al., 2020). Education settings (i.e., pre-schools and schools) are extremely noisy environments, but the noise is rich with information (Shield & Dockrell, 2008; Crukley, Scollie & Parsa, 2011). Hearing impaired children are consistently shown to be dramatically disadvantaged academically relative to their normal hearing peers (National Deaf Children's Society, 2019). This difference is evident from the first year of primary school and continues through to adulthood.

Mild-to-moderate hearing loss (MMHL) is a neglected diagnostic group, despite covering 57% of children with hearing impairment in the UK (Consortium for Research in Deaf Education, 2021). Currently, there are no NICE guidelines regarding the assessment or management of MMHL in children. Furthermore, there is no clear evidence regarding what interventions are optimal for children with MMHL (e.g., clinical trial NCT03771287 - Stewart et al., 2022). The funding and care routes for these children and their families vary across the UK with health professionals working in parallel or in collaboration with teachers of the deaf.

During summer 2023 we ran workshops with audiologists, teachers of the deaf, researchers and, importantly, children with MMHL and their caregivers. The project aims were to discuss 1) routes to participation in hearing research regarding children with MMHL; and 2) future research priorities for children with MMHL across the UK. I will present the results from the workshops centered around infants and pre-school children.

A43 Multimodal verb input to children with and without hearing impairment

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Embodied theories of language point to a direct link between language and action. Of particular importance is how this link might be leveraged by normally hearing (NH) and hearing impaired (HI) infants. Research suggests that caregivers perform their actions in temporal synchrony with language and this may aid infants in discovering relationships between words and referents. Yet research on HI infants is scarce. Additionally, research has explored the multimodal labelling of nouns and less so the multimodal behaviours accompanying verbs.

Here, we used the Ambrose et al. (2016) corpus with video recordings of free-play interactions of NH and HI infants. We analysed 13 dyads from each group at 14 months of age.

We coded multimodal verb episodes produced by caregivers, within a time-window of three seconds before/after a verb spoken. Within those intervals we distinguished between two types of multimodal behaviours: depictive and other. Furthermore, we specified the agents of each verb as either caregiver-led or infant-led, depending on whether the verb spoken referred to a caregiver or infant action.

We found that a big proportion of caregivers' spoken verbs were accompanied by synchronous multimodal behaviours: HI group: $M = 43\%$, $SD = 17\%$; NH group: $M = 34\%$, $SD = 8$). A mixed ANOVA showed a significant main effect for type of multimodal behaviour ($F(1, 24) = 33.841$; $p < .001$; $\eta^2 = .585$) such that depictive cues were used more frequently than other cues: Depictive $M = 70\%$, $SD = 16\%$; Other: $M = 30\%$, $SD = 16\%$ ($p < .001$). This effect was found in each group separately as well. We also found a significant main effect for agent ($F(1, 24) = 4.982$, $p < .035$; $\eta^2 = .172$): caregiver-led multimodal behaviours ($M = 59\%$, $SD = 21\%$) were used significantly more than infant-led ($M = 41\%$, $SD = 21\%$) ($p = .035$). We also found a significant Group*Agent interaction effect ($F(1, 24) = 4.673$; $p < .041$; $\eta^2 = .163$) indicating that this effect was driven by the HI Group.

Our results suggest that parental multimodal strategies are frequently used with NH and HI infants. In both Groups, caregivers predominantly performed actions that depicted the meaning of spoken verbs. These language-action events were in a tight temporal relationship.

Yet the two Groups also differed; caregivers of HI infants used multimodal labelling more frequently when using verbs that referred to their own actions rather than their infants'.

A44 Multimodal communication between deaf children and hearing caretakers in the presence of sensory and communication asymmetries

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Deaf and hearing children are sensitive to language and progress through similar developmental milestones when immersed in a language-rich environment (Lillo-Martin and Henner, 2021). Access to and opportunities for communication, however, are often delayed for deaf children growing up in predominantly hearing and non-signing family contexts. That leaves them at risk of language deprivation during the critical period for (language) development (Hall et al., 2019).

Taking a social-constructivist approach, the present study explores multimodal communication during moments of joint attention in early caretaker-child interactions. More specifically, we investigate how individuals with different experiences and resources of communication use multimodal communication strategies in order to accommodate sensory and communicative needs in initiating and sustaining joint attention.

Video-recorded data of play sessions between caretakers and children (9-24 months) with severe to profound hearing loss were collected in collaboration with the Yorkshire Auditory Implant Service at Bradford Teaching Hospitals, NHS Foundation Trust (UK). The play sessions were recorded at a stage in the paediatric assessment pathway that preceded (potential) cochlear implantation. Data from a total of six caretaker-child dyads are currently analysed with ELAN, an annotation tool for audio and video recordings (ELAN, 2022). We identify multimodal communication strategies – auditory, visual and/or tactile – used within the individual caretaker-child dyads and also look at them across dyads in relation to moments of joint attention. We examine both the caretaker’s and the child’s communicative behaviour with regard to individual affordances, context and the interactional situation.

Moving away from predominantly language-driven approaches of the past, this study provides a template for systematic multimodal analysis that reflects the multimodal nature of communication and accounts for contingency and synchronicity in the process of meaning making that does not always become apparent in a purely linguistic framework but equally shapes and supports communicative behaviour.

The application of findings, emphasising individual resources rather than deficits, is relevant to early intervention with families and provides caretakers with guidance on how to make communication accessible to their child, especially within the critical

period of the first year/s of life that form the building blocks for (language) development.

A45 How does visual salience affect autistic and neurotypical children's visual attention and accuracy during novel word learning?

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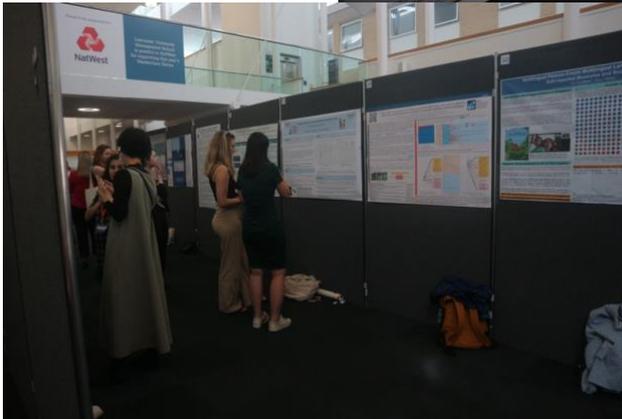
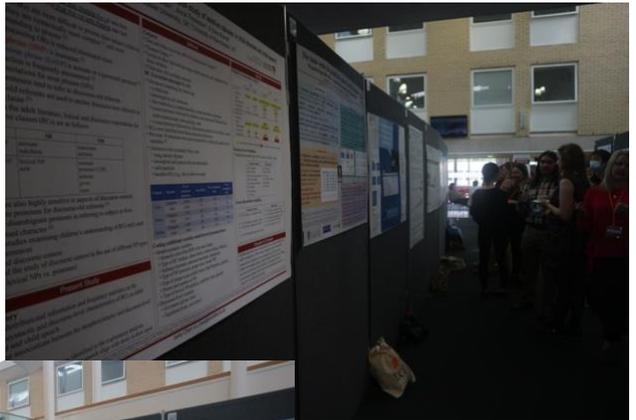
Word learning is vital for language acquisition (Patael & Diesendruck, 2008) which, in turn, is fundamental to children's social and cognitive development (Carpenter et al., 1998). Theoretical accounts propose that autistic children's delayed language acquisition may be attributed to attentional differences that disrupt the intake of visual and auditory information (Hartley et al., 2019; Venker et al., 2018). This theory will be tested by investigating whether autistic and neurotypical children differ in their visual attention and/or accuracy during a word learning task where the visual salience of stimuli is manipulated. Currently, children aged 3-12 years old are being taught novel words via a touchscreen computer (with video recording) where the familiar objects are of high or low visual salience and, following a 5-minute delay, children are tested on their retention (storage of word-referent mapping in memory for later retrieval) and generalisation (extension of label to novel referents). Planned analyses will assess 1) whether visual salience influences visual attention and/or accuracy, 2) whether visual attention predicts accuracy in either visual salience condition, and 3) whether any effects in 1) or 2) differ between autistic and neurotypical children. This research aims to contribute towards our understanding of the underlying causes of autistic children's delayed language acquisition and identify ideal word learning conditions for autistic children.

A46 Is autistic children's word learning facilitated or hindered by high-interest distractors?

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Word learning is influenced by children's attention and interests – determining correct word-referent mappings requires paying attention to the right things at the right times. Whilst autistic children's fundamental word learning mechanisms appear to be intact, their perseverative interests and atypical attention allocation may affect their ability to flexibly engage with the environment and stimuli, thus influencing word learning. Here, nineteen neurotypical children and eighteen autistic children matched on receptive vocabulary (autistic $M = 56.78$ months, neurotypical $M = 60.26$ months) were taught novel word meanings via a touchscreen computer task in a within-subjects study design. During referent selection, competitor stimuli were high-interest animal distractors. In the 'high-interest' condition children learned names associated with novel animals, and in the 'neutral-interest' condition children learned names associated with novel objects. Both groups identified novel names for unfamiliar animals and objects with comparable accuracy at referent selection and 5-minute retention. However, after 24-hours, autistic children were more accurate to identify novel objects compared to novel animals. Superior 24-hour retention accuracy was predicted by greater interest in animals for autistic children. The conditional difference at 24-hour retention suggests that during training, the greater perceptual contrast between familiar and novel stimuli in the object condition allowed autistic children to encode additional information about the more categorically salient novel objects, thus improving long-term retention. Moreover, the influence of animal interests on autistic children's long-term retention suggests that heightened attention to non-target competitors during mutual exclusivity ultimately ensured more robust encoding of word-target representations. Since the presence of interesting distractor stimuli enhanced autistic children's encoding of novel word-referent associations by increasing attention across the whole visual scene, it is possible that reduced interest in the overall word learning contexts could be detrimental to vocabulary acquisition. These findings highlight how learning environments may be optimised to enhance autistic children's language development.

POSTER SESSION 2



B1 “Seeing and knowing are two different things” unless you are a two-year-old

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Two-year-olds can hide an object behind a small screen by moving the object but not by moving the screen (McGuigan & Doherty, 2002). We claim this is because they do not properly distinguish seeing and knowing. The move-screen condition is difficult because the observer already see-knows the location of the object, and moving the screen does not change this fact. To test this claim we use a blindfold to ensure the observer does not see-know the location of the object when children move the screen. With 145 children aged 24 to 54 months (mean age = 40.91 months, SD = 6.75) we replicate the original findings and show that use of a blindfold improves performance. However, performance improved whether the blindfold was placed before or after the observer had seen the object, providing equivocal support. We discuss whether children compute the observer’s see-know status based on the situation when the question was asked, at which point the observer was blindfolded in both conditions. We speculate that this lack of difference reflects under-development of the episodic memory to track previous perceptual access (see Király et al., 2018). After partialling for age, performance on the move screen condition positively correlated with performance on gaze judgement tasks (Doherty et al., 2004). There were no specific relations with theory of mind tasks (Knowledge Access and False Belief; Wellman & Liu, 2004). We suggest move screen success indicates the transition from a behavioural to a mentalistic strategy.

B2 Same difference or actual difference? Object permanence and identity in 10- and 14-month-old infants

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Much research over the past decades has concerned itself with the development of early object concepts, yet findings on the emergence of object identity knowledge are inconsistent and inconclusive. There is evidence to suggest that a rudimentary concept of object identity is present from 4 months onwards (Moore et al., 1978; Wilcox, 1999; Mareschal & Johnson, 2003), though findings are limited to identifying changes in shape, size or location. Featural identity representation (e.g. color, pattern or texture) is reported much later from 7.5 months on (Wilcox, 1999; Oakes et al., 2006; Wilcox et al., 2008; Jackson & Sirois, 2009) and several studies still fail to corroborate identity representations in 9-month-olds (Narter & Rosser, 1996; Káldy & Leslie, 2003). A host of these findings stems from cumulative eye tracking metrics, such as looking times, which have recently raised concerns about conventional implementation and interpretation (Aslin, 2007; Jackson & Sirois, 2022).

In this study, we investigated whether infants continue to represent objects and their respective featural identities once these objects are (temporarily) out of sight. In lieu of looking times, we measured infants' violated object expectations as relative changes in pupil diameter, allowing for temporal analysis of cognitive activity. Across 12 test trials, 10- and 14 month-old infants were presented with short videos in which toy objects either (1) disappear post-occlusion (unexpected permanence violation), (2) are replaced with novel objects post-occlusion (unexpected identity violation), or (3) reappear post-occlusion (expected control). Pupil diameter and eye movements were recorded with a Tobii Pro Spectrum-1200 eye tracking system.

We used linear mixed effects modeling to estimate pupil dilation by experimental condition and age during outcome. Preliminary results (10m: $N=44$, 14m: $N=30$) indicate a positive association between condition and pupillary responses. Infants' pupils dilate significantly when objects unexpectedly disappear ($\beta=.18$, $SE=.02$, $t=7.1$, $p<.001$) and, to a lesser degree, when objects unexpectedly change their identity ($\beta=.06$, $SE=.02$, $t=2.66$, $p=.009$). We argue that these patterns in pupillary responses are indicative of violated permanence and identity assumptions. This suggests that 10- and 14-month old infants have acquired object concepts that draw on spatiotemporal and featural information. Contrary to our assumptions, there was no effect of age. As data collection is still ongoing, results may be subject to change.

B3 Infants' categorization of facelike objects: How does visual context shape early brain representations?

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Face-pareidolia is an illusory perception of a face in objects or patterns [1]. Although it is an illusion, it activates brain regions that are typically dedicated to the processing of faces [2]. This study aims to explore how visual context and infants' visual experience shape the internal representations of these facelike objects. Facelike objects are used here because their ambiguous nature offers many ways to plasticity [3]. We also took advantage of the steady state evoked potentials (SS-EP) technique deriving from electroencephalography (EEG), which principle is based on the fact that the brain synchronizes to any kind of visual information presented in a periodic fashion [4]. SS-EP is particularly suited to test infants because it allows for short and efficient recordings, has an excellent signal-to-noise ratio and is immune to most artifacts [5]. In addition, we conceived an interlaced SS-EP design where 4 to 6 months infants are exposed to 20-second sequences of natural images presented at a rate of 6 images per second (6 Hz). Sequences differ regarding the context in which facelike stimuli are presented: a face context for odd sequences and a house context for even sequences. In this interlaced design, facelike stimuli are also repeated every 5th stimulus, so at the frequency of 1.2 Hz, and faces or houses every 4th stimulus, so at the frequency of 1.5 Hz. When fully collected, infant EEG data will be correlated with indices about their experience with faces collected through Ecological Momentary Assessment (EMA) questionnaires [6]. In a similar experiment with adults, we found that facelike objects generated a significant brain response, which the visual context modulated. In particular, we found that, in adults, the face- and house-context elicited facelike stimuli to be interpreted as objects and faces, respectively. With infants, we rather expect the brain responses to facelike objects to be weaker than in adults because of the protracted development of the face processing system [7]. In addition, they are foreseen to be enhanced in the face context because of the familiarity these salient stimuli elicit at such a young age [8].

B4 Infant sensitivity to sartorial and ornamental signals of "ethnic" identity

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Humans have signaled social identity and group origin for millennia through body modification and adornment such as tattooing among Visayans, Bedouin nose rings, and Indian saris. Body adjuncts have rivaled biological features as obvious ways to recognize groups and infer social information.

Considerable literature demonstrates that infants distinguish persons based on race (Kelly et al., 2005). However, little research has explored how infants use non-corporal information, like clothing, to categorize people. Racial bias studies purport to show that infants associate cue valence with race— positive with same and negative with other (Xiao et al., 2017). This has been interpreted as evidence for an inborn own-race bias (cf., Pun et al., 2018). However, given that sustained contact with diverse physical types is too recent to have allowed an inborn selection preference, others have argued against this interpretation (Cosmides et al., 2003, Hirschfeld, 2012).

Alternatively, contact with peoples who differ in sartorial appearance—embodied branding—is ancient, affording the possibility for an evolved psychology supporting a domain-specific readiness to categorize individuals based on their tailored appearance. Consequently, humans may invest considerable inferential potential in group identity signals, perhaps associating group identity/affiliation signals with other meaningful qualities, such as languages spoken, origin locations, and kinship.

Our research aims to explore infants' readiness to seek out group identity signals and reason about their inferential potential. Experiment 1 adapts Fulkerson and Waxman's (2007) categorization task to examine whether infants use ecologically valid differences in unfamiliar costumes to group people. Experiments 2 and 3 investigate infants' abilities to associate novel sartorial styles with unfamiliar languages.

B5 Do 18-month-olds relate an adult's emotional expressions to transient action effects?Maria Pflüger¹, David Buttelmann², and Birgit Elsner¹¹University of Potsdam, Potsdam, Germany, ²University of Bern, Bern, Switzerland

At 6 months, infants perceive human agents' reaching for a particular object as goal-directed (Woodward, 1998). However, besides object-directed reaching, emotional expressions are another crucial way to indicate goals. At 12 months, infants can relate a person's positive affect to a goal object, and expect the person to reach for the object she had previously emoted about positively (Phillips et al., 2002). Thus, emotional expressions are an essential source for infants when trying to identify another person's goals (e.g., Repacholi & Gopnik, 1997). However, in real life, action goals only sometimes consist of an object that is grasped. Frequently, the goal of one's actions is to elicit some effect in the environment, e.g. pressing a button to turn on the light. In the latter case, determining a person's action goal often requires to relate this person's emotional expressions to a transient effect (e.g., the light) that is not permanently visible. Our study aimed to test whether 18-month-olds were able to identify transient effects as the cause for another person's emotional expressions. In a violation-of-expectation eye-tracking study, we presented infants with videos depicting three adults. The "actor", sitting in the middle, performed two simple actions on a toy, eliciting either a sound or a light effect. Upon the appearance of the effect, one of the "observers" sitting to the actor's sides reacted excitedly, while the other stayed inexpressive. Throughout eight familiarization trials with four toys, infants watched a constant pairing of the observer and the reacted-to action effect (e.g., observer A – sound, observer B – light). In the following test phase, we presented four novel videos, with each observer reacting positively to either the same (congruent) or the other effect (incongruent). Data collection is almost finished. We will analyze looking times, gaze behavior, and pupil dilations by means of mixed models. Systematic differences in infants' reactions to congruent and incongruent test videos would indicate that 18-month-olds can extract action effects as targets of another person's emotional expressions. This provides the basis for an understanding of complex action goals consisting of transient changes of the environment rather than solid objects.

B6 Infant preference for infant voices: An online study

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Infants have been shown to display a preference for listening to other infant's vocalizations (Masapollo et al., 2016; Polka et al., 2014, 2022). In our prior studies, it was noted that infants often vocalized and smiled during listening preference tasks but these behaviors were not coded. This study was designed to gain further insights into what underpins infants' preference for infant speech by measuring the listening preference across a wider age range and assessing other responses that infants display during the task. We conducted a look-to-listen task with English-learning infants aged 4 to 12 months using the Lookit Platform for online data collection. We used the Variable Linear Articulatory Model (VLAM) to synthesized "ee" /i/ and "aw" /a/ vowels simulating an infant and an adult voice. The preference task had 8 trials; on each trial the same vowel was presented 10 times. An image was presented while the vowel stimuli plays, and infants' responses were recorded over the webcam. Different vowels simulating different voices were presented (in random order) across trials (two woman "ee" trials; two woman "aw" trials; two infant "ee" trials; two infant "aw" trials.) The study lasted roughly was 5 minutes.

To date, 90 infants have entered the study. Data analysis is underway but preliminary results are not yet available. The dependent variables in this investigation include infants' looking (listening) time, vocalizations, and facial muscle movements (indexed in facial action units). We anticipate that infants will exhibit a longer looking time toward the screen when presented with infant voices as compared to adult voices, and that they will vocalize more in response to infant voices. To assess facial movements, we employ the Noldus Baby Face Reader software, a tool designed to analyze facial expressions and muscle activity in infants. We expect that smiling will differ when infants listen to a woman versus an infant voice. Aside from smiling, the facial movement analyses are exploratory. The findings may offer new insights into the role of infant voices in shaping early social and linguistic experiences and also point to potential benefits of infants interacting with their peers. To our knowledge, this is the first study to use facial movement analysis to assess infant responses to speech. Thus, we will also learn about the potential utility of facial movement analysis to augment (or replace) looking time in remote infant test protocols.

B7 Examining the emergence of spatial rule representation: Investigating spatially bound social goals in early cognitive development

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This study investigates the developmental trajectory of infants' comprehension of place-specific rules that organize social interactions, complementing existing research on agent-based reasoning. In doing so, it provides a more comprehensive understanding of the cognitive processes underlying social development during infancy. The study's premise is based on a neurocognitive foundation, with the Fusiform Face Area (FFA) and the Parahippocampal Place Area (PPA) implicated in Theory of Mind (ToM) and spatial representation, respectively (Baron-Cohen, 1997; Epstein et al., 1999; Kosakowski et al., 2022).

Considerably research has demonstrated that human infants represent the world in a way that provides an enriched understanding of the social world facilitating the mapping and navigation of complex social environments. Much work has demonstrated that this includes explicit agent-based interactions contingent on attributions of intentions. Less attention has been directed toward investigating infants' comprehension of spatially-bound rules shaping behavior within social contexts.

Expanding upon Woodward's (1998) habituation paradigm, which demonstrated that infants as young as five months old privilege outcomes (indicating intentionality) over actions, this study examines six-month-old infants' responses to agents performing a specific action (i.e., object "drop off") within a particular three-walled space (i.e., the place) displayed on a screen. Infants will be habituated to these actions and subsequently tested against novel conditions (other-place vs. placeless) to assess whether they prioritize place over action. In this context, the other-place is defined as a hemi-circular walled space, while placeless refers to an arbitrary location on the screen without any walls defining a finite space. The presence of an N400 event-related potential (ERP) component in the other-place and placeless conditions would indicate that infants have representations of spatially-bound social goals.

B8 Exploring the link between the neural correlates of processing facial emotion in infancy and prosocial behavior at 3 years of ageRenata Di Lorenzo^{1,2}, Winko W. An^{1,2}, Michelle Bosquet^{1,2}, and Charles A. Nelson^{1,2}¹*Boston Children's Hospital, Boston, USA*, ²*Harvard Medical School, Boston, USA*

Prosocial Behavior (PB) has been associated with school performance and psychological well-being^{1,3}. Thus, supporting PB at an early age is critical to enabling children to reach their full potential later in life. To do that, it is essential that we identify the factors contributing to individual differences in PB in the first years of life. One factor possibly affecting PB is facial emotion processing. Extracting emotional information from faces provides infants cues to help them develop social skills. Previous research indicates infancy as a critical period for facial emotion processing⁴. An fNIRS study showed that 7-month-olds' brain responses to fearful faces predicted PB at age 14-months². While this evidence suggests a link between infant facial emotion processing and later PB, more research including a wider age-range is needed to clarify this relationship in the first years of life. In our study, we correlated event-related-potentials (ERPs) recorded from three groups of infants (tested at either 5, 7, or 12 months of age) during passive watching of fearful, happy, or angry faces with PB data obtained at age 3 years. We computed mean amplitudes of face-relevant ERPs (N290, P400 indexing visual- and Nc attentional-processing) separately for each infant group and emotion; while PB was operationalized as the amount of time a child waited prior to helping an experimenter who was having difficulties completing a task⁵ (hereafter prosocial latency). We hypothesized that PB at 3 years would be related to infant ERPs. Analyses suggest that more negative Nc to angry faces at 7 months was associated with shorter prosocial latency at 3 years ($r=.46$, $p=.027$). This result indicates a link between infant (attentional) facial emotion processing and PB at 3 years, which is in line with previous research². Ultimately, this evidence highlights the importance of supporting socio-emotional development in the first years of life.

B9 Multimodal study of neural synchrony during naturalistic problem-solving in preschoolers and mothers

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Real-world problem-solving in childhood often happens in collaboration with others. Children must be able to synchronise their behaviours (e.g., eye gaze and movement) with that of their interactive partner to accomplish a shared goal. Brain-to-brain coupling has been proposed as a possible mechanism underlying children's ability to coordinate their interaction with another person (Wass et al., 2020). However, unpacking the possible relationships between neural synchrony and social learning is methodologically challenging, particularly in young children. It requires measuring multiple, freely moving people simultaneously during a naturalistic task and, with children, developing both child-friendly hardware and data processing pipelines. This study employs wearable neuroimaging and eye-tracking technology to investigate collaborative problem-solving in four- to six-year-olds during naturalistic interaction with their mothers.

Data is currently being collected from $N = 40$ dyads of mothers and their four- to six-year-old children at Birkbeck, University of London's Centre for Brain and Cognitive Development. During the experiment, mothers and their children sit face-to-face on either side of a table. Dyads are asked to arrange Tangram puzzles according to different templates (e.g., cat or house) (Nguyen et al., 2020). They complete puzzles in three conditions: (1) fully cooperatively, where they can work together, (2) partially cooperatively, where a short screen blocks their faces, but they can see each other's hands, and (3) fully individually, where a long curtain is drawn between them, and they solve their own puzzles separately.

Both mother and child wear a mobile functional near-infrared spectroscopy (fNIRS) system (Brite MKII, Artinis Medical Systems BV, The Netherlands). We measure changes in brain activity in regions that have been previously shown to support social mentalising in a cooperative setting, the right and left dorsolateral prefrontal cortex and temporo-parietal junction (Nguyen et al., 2020). Each participant is also fitted with a head-mounted Pupil Core eye-tracker (Pupil Labs GmbH, Berlin, Germany). The system tracks pupil movement and contains a scene camera to record the participants' world view.

Results have not yet been analysed. We expect neural synchrony to be higher in the full cooperation condition compared to the cooperation with screen and individual conditions. We also expect synchrony will be sensitive to multimodal social cues, such

as direct eye gaze (Leong et al., 2017; Piazza et al., 2020). Overall, we show that it is possible to collect multimodal, hyper-scanning data from pre-schoolers during freely moving, naturalistic interaction.

B10 Deciding to help by preverbal infants: A novel gaze-contingent eye-tracking paradigm

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Infants are capable of attributing value to the interactions of animated agents who help and hinder one another (Premack & Premack, 1997). Furthermore, an impressive collective body of research has demonstrated that infants prefer to look at more and choose agents helping others than hindering agents (Hamlin et al., 2007, 2011). However, all these studies have shown only infants' preferences by measuring their looking time and reaching for a prosocial character (Lavoie et al., 2022). Although infants prefer prosocial agents more, it is unclear if this knowledge enables them to help others. Additionally, studies have shown that infants can reliably help an adult in action-based situations during the second year of life (Laible & Karahuta, 2014). However, much less is known if they are cognitively capable of helping someone before they reliably begin to help physically. Hence, evaluating agents and doing moral tasks should be considered together (Lavoie et al., 2022). Therefore, we aim to examine if infants can decide to help an agent needing help with the support of another agent in a novel gaze-contingent eye-tracking paradigm. We set up three conditions: Helping, Hindering and Control Condition. In each condition except for Control Condition, infants were habituated with the Green Button (GB) condition, after fixating the GB, an agent gaze-contingently appears on the screen. Thus, an association between GB and this agent (either helping or hindering) was established. Then, infants were shown two animations in which this agent helps another agent in Helping Condition, hinders another agent in Hindering Condition, and stays neutral in Control Condition. Finally, in testing condition, all infants were shown an animation including GB on the screen and a testing agent falling in a hole and requesting help. After the last help request, we arranged 10 seconds in which infants can trigger the GB to call the first agent to help, or if they do not trigger the GB, the testing session ends. The frequency of eye fixations on the GB in testing condition are analysed via Areas of Interest (AOI), and conditions are compared via ANOVA analysis. Thus, we aim to provide evidence of if infants can call for help by using the GB and provide a unique perspective on infants' social evaluation literature by showing that beyond preferring prosocial agents, infants are cognitively capable of helping others before their physical development allows them to help others.

B11 A novel approach to human-object processing in typically developing infants and infant siblings: Attention orienting, face scanning and engagement in interactive gaze-contingent conversation eye-tracking paradigm

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Engagement with more objects than humans is the first major pattern noticed in identifying autism spectrum disorder (ASD) as a disorder by Kanner in 1943 (Kanner, 1943). Furthermore, several studies aiming to uncover early markers of ASD demonstrated that impairments in attention and orientation to social stimulus begin to emerge in the first year of life in infant siblings (infants who have at least one biological sibling with ASD diagnosis and genetic risk for ASD) (Tanner & Dounavi, 2021) and low looking at the human than an object in a conversation is related to higher ASD symptoms (Macari et al., 2021). However, much less is known about whether infant siblings show deviant responsiveness to humans and objects in a more structured and interactive setting, enabling infants to engage directly with humans and objects. Therefore, we aim to investigate if infant siblings can be distinguished from their peers in attention, face scanning and behavioural responsiveness to an interactive conversation initiated by a human and a puppet. The experiment setting comprises two conditions: Human (including three Caucasian females) and puppet speaker condition (including a puppet having a closer match with a human face). In addition, the gaze-contingent conversation eye tracking task was applied. In this task, infants can trigger the human/puppet's conversation on the screen after making eye contact. In each condition, infants were exposed to 15 sentences based on three daily topics: welcoming the baby, daily routines, and games. Sentences vocalised by three female adults were also merged and synchronized with the puppet's move whilst pretending a speech. The order of speakers and contents of conversations were counterbalanced. Infants were randomly assigned to one condition. Both eye-movements and behavioural responsiveness were recorded. Data collection is ongoing. To date, 124 infants (116 typically developing, 8 infant siblings) were tested. Preliminary analysis suggests that infant's eye movements differ between human and puppet conditions with more looking to the mouth in the human condition. Further analysis of eye movement data, behavioural response data and infant sibling responses is still ongoing. We aim to provide evidence about if infant siblings show any abnormal approach to the human and the puppet in an interactive context and to discuss if this could hold promise to detect early signs of ASD. We hope to contribute to enabling the early detection of deviant behaviours related to ASD symptoms within the first year of life.

B12 Gaze-contingent eye tracking studies with infants: Challenges and solutions

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Gaze-contingent eye tracking – changing of the screen display or triggering actions depending on where a participant looks on a screen – presents exciting opportunities for research with infants. Specifically, this method can assess infants' learning of contingencies, and their active information selection in a well-controlled environment. Here we discuss our experiences of the challenges of adopting this paradigm for infants (having so far tested 36 infants aged 18-23 months), with the hope that this might be beneficial for other labs planning to use this method. Specifically, we faced the following challenges: 1) Deciding when to trigger an action: Typically, an action is triggered when the participant has fixated a specific screen location for a minimum amount of time (prior studies have ranged from 150-700 ms). As infants do not look at the screen consistently, it is important to consider how large the to-be-fixated area is, and whether or not to accumulate time over look-aways. In making these choices one needs to consider that the infant must 'know' that they have triggered the action. 2) Forcing exploration: When different stimuli on the screen trigger different actions, it may be important for the infant to trigger all actions for a trial to be valid. However, we found that many infants stick with the first action they have triggered and trigger that action repeatedly. We describe methods that we have used to overcome this challenge, including pre-training and occluding previously triggered stimuli. A discussion is also warranted on whether forcing exploration leads to a qualitatively different experience for the infant, and thus underpins a distinct cognitive mechanism. 3) Choosing the right age group: We found that 20-23-month-olds provide far more robust data than 18-month-olds. This might be due to their increased ability to sustain attention, which needs to be carefully considered in each particular study. 4) Using attention getters: The main premise of gaze-contingent paradigms is to enable intrinsically-driven, free exploration. Nevertheless, we found that this paradigm did not seem to be intrinsically more interesting to infants than traditional looking-time studies, and the typical efforts had to be made to attract infants' attention to the screen. Together, these considerations show gaze-contingent paradigms to be a promising but challenging method to study infant cognitive and social development.

B13 The age of reaching early developmental milestones in Polish-Lx bilingual and Polish monolingual children

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Establishing developmental trajectories in children's language acquisition may inform both psycholinguistic theory and practice, telling us which individual patterns of language development are typical in the population. The issue of typical developmental trajectories gains additional importance in the case of bilingual children, whose language exposure is often quantitatively (and qualitatively) different from that of monolinguals.

We investigate early developmental milestones in bilingual children from 0 to 3 years of age with Polish as L1 (and various L2s), and we compare them to Polish monolingual peers. The milestones under investigation are both non-linguistic (crawling, walking) and linguistic (babbling, production of first words, combining words into sentences). Information on the age of children reaching these milestones is gathered with a custom mobile app ("StarWords - every word counts") in which parents provide information on their child's development and enter gestures, words and utterances their child produces. Additionally, by collecting information on the children's linguistic environment (via the same app), we can compare the children's quantity of reported language exposure overall and in activities such as book reading, play time, singing and media use.

In our talk we will present preliminary results and discuss the opportunities and challenges of our method of data collection. Up till now, we have gathered data from over 640 bilingual families from all over the world and over 2,200 Polish monolingual families with children aged from 0 to 30 months. However, a relatively small fraction of parents (up to 10%) have been reporting their child's language development for more than two months.

The data was examined using Bayesian inference. We found that bilingual children reached developmental milestones at a similar age to their monolingual peers, apart from combining words into sentences, which yields inconclusive results. At the same

time, our results indicate possible differences between the two groups in terms of their overall exposure to L1 Polish (measured in hours) and exposure to L1 Polish in particular daily activities, such as book reading and play time. Overall, these results suggest that while bilinguals may typically hear less of their L1 than their monolingual peers, they reach important developmental milestones at a similar age to monolinguals. To the best of our knowledge, this is a first comparison of the bilingual and monolingual early language trajectory as measured by first language milestones.

B14 The relation between attention, multiple types of memory and vocabulary development in toddlers

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The "shape bias" is the tendency of both children and adults to generalise newly learned names for solid objects based on similarity in their shape (Smith, Jones, Landau, Gershkoff-Stowe & Samuelson, 2002). Research conducted over the last 30 years has linked the development of the shape bias to the early noun vocabulary: children learn many names for categories organized by shape similarity (Perry & Samuelson, 2011; Samuelson, 2002) and late talking children do not show a shape bias talking children (Jones, 2003).

Recent research by Bakopoulou et al. (2023) replicated the relationship between the shape bias and vocabulary in 2-year-old children with typical language development.

In addition, they demonstrated a relation between visual attention in the Novel noun generalisation task and vocabulary—the more words in children's vocabulary the quicker they were to look to shape-matching test objects when generalizing novel nouns. They suggested one possible reason for this was that children who knew fewer nouns needed time to refresh their working memory representations of the objects before making a generalization decision (c.f., Vales & Smith, 2015, 2018).

This idea fits with recent work linking vocabulary development to multiple memory systems. For example, children who had better object memory were better in learning new words (Vlach & DeBrock, 2019), and a meta-analysis by Pickering et al. (2021) emphasized the importance of visual memory in vocabulary development. Other work suggests pre-schoolers with specific language impairment (SLI) struggle to learn simple pairs of visual objects and do not develop shape bias as typically developing children (Collisson et al., 2015). Together, these findings indicate the importance of memory and visual processing in early vocabulary development.

The goal of this study is to examine relations between the shape bias, children's vocabulary, visual attention, and memory. We used an eye tracker to get fine-grained measures of children's attention during a novel noun generalization task with 3D stimuli and collected data on children's vocabulary, working memory, object memory and retention of novel names. We have currently collected data from 47 18- to 26-month-old children, out of a planned sample of 60. We will examine these in relation to Oxford Communicative Developmental Inventory (OCDI) scores.

LCICD 2023

The findings will be discussed in the context of prior proposals regarding a developmental cascade of multiple attentional and memory systems supporting early word learning and how this may differ in children who know more and fewer nouns.

B15 Which executive functions are the best predictors of mindful conversational skills throughout preschool?

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Background:

To be able to converse skillfully with other people requires social understanding such as taking the perspectives of conversational partners. Young children need to interact with their peers and teachers when they start preschool. Mind-reading literature suggests that theory of mind understanding is a paramount for such social understanding. There are early individual differences in executive functions (EFs), which have been shown to predict later variations in theory of mind understanding (Devine & Hughes, 2014). It is possible that social understanding could have its early foundation in the area of EFs.

Objective:

To investigate early foundations of mindful conversational skills in EFs, the present study followed 321 three-year-old children over three years to address whether early EFs predict later performances of mindful conversational skills, as evaluated by preschool teachers who know the child best in the preschool setting.

Method:

For EFs, three components: working memory, shifting attention, inhibitory control were measured. During the first year in the preschool, EFs were measured twice: once during the first three months of school entry and then again three months after the first measurements. Receptive language was also measured along with EFs.

The classroom teachers assessed the children's performance based on mindful conversational skills (Peterson, Garnett, Kelly, & Attwood, 2009) at the end of each academic year.

Results:

The three components of EFs were represented by three latent variables and they predicted the latent variable for mindful conversational skills over three years.

Structure Equation Modelling indicated that the model fit was good: chi-square = 58.3 DF= 34, $p = .006$, RMSEA = .053, CFI=.967, GFI= .993, and SRMR = .042.

Parameter estimate revealed that early measurements of inhibitory control but not working memory and shifting attention was a significant predictor of mindful conversational skills.

The implications of these findings are: individual differences in early EFs predict children's conversational skills performance during preschool. Early EFs, particularly inhibitory control is one of the key components to focus on when facilitating social development.

B16 Are babies' cries already language?

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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, *Curr. Biol.*), although these results have generated a debate and require further confirmation (Gustafson et al., 2017, *Infancy*; Manfredi et al., 2019, *Biomed. Signal Process. Control*). 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. 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, while adults show a more pronounced response to speech compared to cries. 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.

B17 Parental cell phone texting and word learning in children

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Our society is concerned with the effects of mobile devices on children's language development. However, only a few studies such as Reed, Hirsh-Pasek, and Golinkoff's (2017) tested the impact of parental cell phone use on children's language learning. 38 mothers taught their 2-years-old two new words. Half-way during one of the teaching periods, mothers were interrupted by a 30s phone call. Results showed no learning of the new word in the interrupted condition, as opposed to the uninterrupted condition, suggesting that distraction from mobile devices can negatively affect early word learning.

Following Reed et al. (2017), this current study investigated whether parental texting interruption affects word learning in children, as texting better reflects the main usage of cell phones. In another depart from Reed et al. (2017), we manipulated the instructions provided to parents. At the start of the experiment, half of the parents were told the true purpose of the study (scenario 1): "we are interested in how a phone text can be a distraction for a learning task". The other half were provided with a cover story (scenario 2): "we are interested in how parents feel while they teach something new to their infant". In this 2x2x2 mixed design, 42 parents taught their 18-month-olds two novel noun words, one at a time. They were given 60 s to teach each word. One teaching period was interrupted by a phone text which asked parents to fill a questionnaire on their phone (approximately 30 s). Another teaching period for the second novel word was not interrupted (order counterbalanced). In the test phase, eye tracking was used to assess children's comprehension of the novel words (corresponding to novel objects) in an intermodal preferential looking task. A 2 (interruption: present, absent) X 2 (order: interrupted first, interrupted second) X 2 (scenario: 1, 2) mixed-design ANOVA indicated that, contrary to Reed et al. 's (2017), interruption did not interfere with children's learning. However, findings showed children whose parents were given scenario 1 learned better the target words than those whose parents were given scenario 2. Parents who were made aware of the potential distraction of texting were presumably more motivated to compensate during the learning phase and filled in the questionnaires faster than those provided with scenario 2. More than the effect of mobile phone use, these findings point to the strong impact of parental attitude in word learning situations.

B18 Can interleaving facilitate minimal pair word learning in infants? Testing a new word-learning procedure

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Learning minimally different words like *bih/dih* is challenging for infants at 14 months (Stager & Werker, 1997), unless additional cues as for example speaker variability are provided in the input (Höhle et al., 2019, 2021; Quam et al., 2017; Rost & McMurray, 2009, 2010). Another type of input variability, namely the order of presentation, has not yet been systematically investigated in this context. Studies with adults (Brunmaier et al., 2019) have shown that interleaving—or alternating—the presentation of category exemplars (abcabcabc) benefits visual category learning in comparison to blocking (aaabbbccc). The aim of the present study was to assess whether this effect is present in the auditory domain for infants' minimal pair word learning.

Thirty-six German-speaking 14-month-old infants (data from 24 in the analysis) were tested on a modified version of the switch task implemented on a Tobii Spectrum eye tracker. The task also included a fixed familiarisation phase with preferential looking trials to measure the emergence of word-object associations throughout the learning phase.

Children had to learn two phonotactically legal pseudowords that differed in the initial consonant (/bu:k/ vs. /pu:k/) paired with two unfamiliar objects (Horst & Hout, 2016). The training phase consisted of six familiarisation blocks where the two word-object pairs were presented in an alternating order for 24s. At the end of each block, infants saw two preferential looking trials where both objects were presented side-by-side while one was named. There were three final test trials with one word-object pair presented in each trial (repeatedly for 14s): Same trials matching the pairing from the familiarisation, Switch trials with an object paired with the 'wrong' word, and a Novel trial containing a new object.

Results revealed that children looked at the familiarisation stimuli for most of the time (77% = 111s, range: 80–137s). The preferential looking trials revealed no learning: The proportion of looks to the target object did not increase after hearing the label and did not differ from chance. The looking duration in the final test trials also did not differ between Same, Switch and Novel trials. Thus, the data provide no evidence that interleaving supports the learning of minimal pairs from a single speaker at 14 months. Currently we are testing 17-month-old infants to evaluate the

new procedure and to interpret the null results, as children at this age are expected to learn minimal pairs.

B19 No evidence of native sound discrimination in Norwegian 9-month-old infants using an eye-tracking habituation paradigm.

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Previous research has demonstrated that infants' language perception undergoes perceptual narrowing between 6 and 12 months of age, evidenced by (1) an improvement in perception of native language speech sounds (Kuhl et al., 1992), and (2) a reduced ability to discriminate non-native language sounds (Cheour et al., 1998). Yet, while this developmental pattern of sound discrimination is expected to be universal, there is little direct empirical evidence with Norwegian infants.

We tested 9-month-old monolingual infants from the greater Oslo area using a habituation-dishabituation paradigm (Houston et al., 2007) on their ability to discriminate between a native vowel roundness-based contrast /y - i/ (N = 57) and two consonant contrasts: /d - d/ and /b - d/ (N = 28). For the latter group, the order of consonant contrasts was counterbalanced, with a short break between the presentation of each contrast. Infants were habituated to one sound and were later measured, through eye-tracking, whether their looking time differed between two test conditions; an alternating presentation of novel and habituated sounds (novel condition) as compared to repeated presentation of the habituated sound (habituated condition). The experiment was fully gaze contingent and only infants that habituated within 24 trials and had at least 1200ms of looking time in at least one trial in each condition were included.

Looking time was log-transformed and included into two linear mixed-effects regressions; the independent variable was condition (novel vs habituated) and we controlled for infant age in days, sex, and maternal education. Our results provide no evidence of differences in looking time between the novel or habituated trials for any of the contrasts, for vowel ($z = 0.88$, $se = 0.07$, $p = 0.38$) or consonants ($z = -0.75$, $se = 0.08$, $p = 0.45$).

Two potential explanations for these null results will be discussed: Either 9-month-old Norwegian infants have not fully established stable discrimination of native speech sound contrasts, or 9-month-old Norwegian infants demonstrate a different pattern of response to the presentation of familiar vs novel stimuli, such that their discrimination cannot be evidenced with this habituation paradigm.

B20 Development and assessment of early word recognition

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Early word recognition is an essential aspect of language development (e.g., Meylan & Bergelson, 2021). However, identifying and measuring individual differences in this ability in the first two years of life is a challenge. Improved methods for assessing early language abilities could enhance our understanding of language development.

In this study we will examine the development of young children's vocabulary acquisition between 10 and 24 months of age. First, we will investigate the validity of eye tracking based methods for studying young children's vocabulary acquisition. Second, we will investigate if early word recognition predicts later word recognition and word production.

Method

Study design and participants

The participants consisted of 70 children and their families. Data collection took place at four time points (10, 12, 18 and 24 months). The study was pre-registered prior to any data analysis (Gerbrand & Forssman, 2022).

Outcomes

Child Language

Parental reports. Receptive and expressive vocabulary was assessed with parent reports on the Swedish Early Communication Inventory (Eriksson et al., 2022) at 10, 12, 18 and 24 months of age.

Eye tracking. Receptive vocabulary was assessed with two eye tracking based tasks. The Preferential Looking Paradigm (modeled on Bergelson & Swingley, 2011) was administrated at 10, 12, and 18 months of age and the Mis-Match Paradigm (modeled on Parise & Csibra, 2012) was administrated at 10 and 12 months of age.

Data analysis

Our primary analysis will consist of zero order correlations and a series of mixed models. Data analysis is currently ongoing and will be finished by May 2023.

B21 Investigating the effects of baby sign on early word learning

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Gesture use facilitates word learning and can be used to predict a child's future language skills (e.g., Iverson & Goldin-Meadow, 2005; Rowe & Goldin-Meadow, 2009), so the use of gesture in children's communication has important implications for language learning. Because of this, a specific form of symbolic gesture known as 'baby sign' has been developed (e.g., Sing and Sign, n.d.), which aims to teach infants signs for key words so they can communicate their needs before they can talk. There are many claimed benefits of this, such as an enhanced vocabulary and increased intelligence (Baby Sign Language, n.d.; Sing and Sign, n.d.), which have led to baby sign growing in popularity (Doherty-Sneddon, 2008). However, there has been limited research into the effects of baby sign on language development, and many of the claimed benefits are based solely on anecdotal data, which is not a valid measure of effectiveness. Therefore, the present study aimed to investigate the effects of baby sign on word learning. The Oxford Communicative Development Inventory (Hamilton et al., 2000) was used to measure infants' word comprehension, and a questionnaire designed for this study was used to assess their knowledge of baby signs. Statistical models of the CDI data were used to determine if baby sign is beneficial to word learning, and to examine both specific benefits and overall vocabulary benefits. So far, data from 34 British English children aged 12-16 months indicates that baby sign does not have an advantageous effect on word learning as a whole, however, learning signs for objects does have a significantly greater effect on the learning of nouns than verbs. This indicates the possibility that there are limited, specific benefits to these signs, which suggests that specific types of gesture may facilitate the learning of different word types.

B22 Associations between shared book reading and vocabulary size are stronger among lower-SES infants

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Previous research suggests that shared book reading during early childhood has a positive impact on language development (Kartushina et al., 2022), while extensive screen time might have the opposite effect (van den Heuvel et al., 2019). In this pre-registered study, we tested the hypotheses that book reading is positively, and screen time is negatively associated with the vocabulary sizes of a large sample of 12- and 24-month-old Norwegian infants from various socio-economic status (SES) backgrounds.

Parents of 12- and 24-month-old infants residing in Oslo, Norway were recruited via birth registries. The sample comprised $n=1442$ infants; $n=556$ (276 girls) 12-month-olds and $n=886$ (465 girls) 24-month-olds. Parents reported their infants' vocabulary size using the Norwegian adaptation of MacArthur-Bates Communicative Developmental Inventories (Simonsen et al., 2014). Parents of 24-month-olds reported production, while parents of 12-month-olds reported both production and comprehension. Vocabulary scores were transformed into age- and gender-adjusted percentiles using Norwegian norms. In addition, parents reported how often they engaged in shared book reading with their infant ('never' to 'several times a day'), and their infants' daily screen time ('none' to '3 hours') in the past four months. The mothers' highest level of education was used as an index of SES.

As predicted, results of our beta-regression models revealed that book reading was positively associated with vocabulary size, both for 24-month-olds' production ($\beta=0.41$, $p<.001$), and 12-month-olds' production ($\beta=0.24$, $p<.001$) and comprehension ($\beta=0.40$, $p<.001$), while screen time was negatively associated with 24-month-olds' production ($\beta=-0.08$, $p=.04$). Exploratory analyses showed that SES interacted significantly with book reading for 12-month-olds' production ($p = .05$). Post-hoc models, run separately for each SES group, revealed that the strength of the association between book reading and 12-month-olds' productive vocabulary declined from low to high SES (β 's= 0.73 , 0.39 , 0.30 , 0.20 , -0.24 , respectively).

These findings suggest that promoting shared book reading and limiting screen time in early childhood could be important factors in supporting optimal language development. Shared book reading may provide opportunities for rich language input in a contingent learning context, in turn promoting vocabulary growth, while screen time may lack this contingency and present an opportunity cost in reducing activities that are more conducive to language learning. Our (exploratory) results on the

differentiating role of SES may point towards shared book reading as a compensatory mechanism in low-SES families, attenuating potentially impoverished learning environment and reduced parent interaction (Golinkoff et al., 2019).

B23 The development on early phonological networks: An analysis of individual longitudinal vocabulary growth

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Is it easier for children to learn the word *cap* if they already know many phonologically similar words like *cat* and *cup*? To investigate the influence of already learned words on the acquisition of new and phonologically similar words, the vocabulary of individual children must be analysed over time, as each child learns in a different way. Previous research has used networks to represent children's vocabulary but based them on data averaged over many children (Fourtassi et al., 2020; Siew & Vitevitch, 2020). Laing (2022) used data from individual children in her analysis, but only had a small data set. Because of the different data and the different phonological distances used in the previous studies, the results of the analyses differ: Fourtassi et al. (2020) showed that words that have many phonologically similar words in the children's linguistic environment are more likely to be learned earlier than words that have hardly any similar words in the environment (EXT). Laing (2022) found that previously learned words that are phonologically similar to many other previously learned words attract similar new words.

Consequently, children would learn these first (INT). However, Siew & Vitevitch (2020) found that both INT and EXT are statistically significant predictors of word learning for children aged 3-9 years. The present work addresses the problem regarding different (non-longitudinal) data and phonological distances. We use a large longitudinal data set of 1,565 Norwegian children (15-35 months) and measure the Levenshtein distance (LD) to build phonological networks of each individual child at different ages. Analyses of these growing networks will show if INT and EXT are significant predictors for vocabulary growth. We verify the outcome against two other measurements of phonological distance, namely the one developed by Laing (2022) and our own method, which measure the phonological similarity of words more differentiated than the LD does. The results show us the relevance of different methods and suggest a strong influence of phonological similarity of words on word learning.

B24 Effects of clause order and connective type on children's production of adverbial clauses

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In English, adverbial clauses can occur in two orders: main-subordinate and subordinate-main (e.g., (1) *He eats a pear after he plays the big drum*; (2) *After he plays the big drum, he eats a pear.*). However, the two orders are not processed equally. Three competing theoretical accounts have suggested that one order may be easier to produce than the other from semantic, syntactic, and frequency-based perspectives (Ambridge et al., 2015; Clark, 1971; Diessel, 2005). The present study tests these competing predictions using a sentence completion task in which clause order and connective type (*after, before, because, if*) are manipulated.

In the task, children are presented with three pictures that depict everyday events in a left-to-right array (e.g., event 1: he drinks water; event 2: he plays the big drum; event 3: he eats a pear), and then are asked to use one of the events to complete a sentence after the experimenter's prompt (e.g., *After he plays the big drum, ... (he eats a pear)*). In addition, children's general language skills, memory, and inhibitory control are also measured to determine their contribution to children's performance.

Preliminary results from 42 three- to five-year-old monolingual English-speaking children show that children complete sentences in which the clause order follows the chronological order of events in the real world (example (2) above) more accurately than sentences where the clauses appear in the reverse order to which the events occur in the real world (example (1) above). These findings suggest that young children construct complex adverbial sentences by assuming a direct mapping between the order of events in the real world and in the linguistic form. We will present full datasets and discuss the theoretical implications of the results.

B25 The influence of embedded noun phrase type and givenness on young children's processing of relative clausesKin Chung Jacky Chan¹, Anna Theakston², and Silke Brandt¹¹Lancaster University, Lancaster, United Kingdom, ²The University of Manchester, Manchester, United Kingdom

Previous research has shown that object relative clauses (ORCs; e.g., the dog that the cat chased) are more difficult to process than subject relative clauses (SRCs; e.g., the dog that chased the cat), for both children and adults. Yet, some studies have shown that replacing the embedded noun phrase ('the cat' in the above examples) with a pronoun can make ORCs easier to process. An experimental study with adults has found that ORCs can also be made easy if the embedded noun phrase is mentioned in previous sentences. Yet, experiments with children traditionally presented relative clauses in isolation, without any discourse context. In a recent corpus study of child-directed and child speech, we found that in child speech, a relative clause is more likely to be an ORC if the embedded noun phrase is not given. However, we also found that a relative clause is more likely to be an ORC if the embedded noun phrase is a pronoun. These patterns of results seem to be contradictory. In the present study, we aim to examine whether and how embedded noun phrase type (lexical noun phrase vs. pronoun) and givenness (new vs. given in previous discourse) individually and/or jointly influence children's understanding of subject and object relative clauses, and whether such influence is modulated by age.

Three- and five-year-olds are invited to take part in two study sessions. In the first session, the children are presented with two pictures (e.g., lion hugging tiger and tiger hugging lion) on a computer screen and asked to press a button to indicate which picture a spoken sentence containing a relative clause (e.g., Where is the tiger that is hugging the lion?) refers to. The embedded noun phrase in half of the sentences is replaced by a pronoun. These sentences are preceded by a contextual sentence which either mentions the animal in the embedded noun phrase position in the up-coming relative clause or an irrelevant object. Eye-tracking is also used to study the online processing of relative clauses. In the second session, the children completed a working memory task – the Missing Scan Task – and a standardised language assessment – the Clinical Evaluations of Language Fundamentals – Preschool 2. We also include a control condition without any contextual sentences. Data collection is on-going, and we hope to be able to present some preliminary data and findings at the conference.

B26 Family socioeconomic status and early life language abilities: A meta-analytic review

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Children of the same age differ greatly in their speech and language abilities. These differences in speech and language ability are systematically related to children's family socioeconomic status (SES). Children from higher SES families are on average exposed to more enriching language environments in their family homes during their early years, which help them develop better speech and language abilities, than children from lower SES families. For example, children from higher SES families tend to hear more words and more sophisticated language and vocabulary than children from lower SES families. The influence of family SES on children's differences in speech and language can already be observed in the first year of life and magnifies as children grow up. By the time children reach school age, SES-related differences in speech and language abilities are profound and strong predictors of children's educational achievement.

Whilst many individual studies have reported an association between family SES and children's speech and language abilities, these studies have not been systematically reviewed. What's more, whether the association varies as a function of language outcome, SES indicator, or child age remains unknown.

This meta-analysis aims to provide a comprehensive estimate of association between traditional markers of SES including a) parental occupation, b) parental education, and c) household income, and preschoolers' speech and language abilities (e.g., phonology, vocabulary/semantics). Here we focus on UK samples to ensure the comparability of family background, as across countries, range and levels of inequality differ.

Our meta-analysis was preregistered, following PRISMA guidelines, on the Open Science Framework (<https://osf.io/ebmy3/>). Over 10,000 relevant publications were identified for screening via PubMed, Web of Science, and Scopus. To derive an estimate of association between family SES and children's speech and language abilities, a multilevel meta-analysis will be conducted to account for effect size dependency due to 'nestedness'. A meta-regression model will be fitted to explore whether the association varies across language measures, SES indicators, and child's age. We hypothesise that parental education will be most predictive of children's language abilities.

This meta-analysis will clarify the strength of relationship between family SES and child language abilities. What's more, understanding which markers of SES are most related to early language abilities or which language outcomes are most influenced by SES, might signify potential pathways to tackle the transmission of family background inequality or indicate potential targets for early language interventions.

B27 The effect of labelling and sustained attention during parent-child interaction on novel-word retentionMing Yean Sia^{1,2}, Rajalakshmi Madhavan^{1,2}, Xiaoyun Chen¹, and Nivedita Mani^{1,2}¹*Psychology of Language Group, University of Göttingen, Göttingen, Germany,*²*Leibniz ScienceCampus Primate Cognition, Göttingen, Germany*

In a naturalistic environment, children are typically exposed to a range of objects they are more or less familiar with. Object novelty impacts how parents interact with and talk about the object (Chen et al., 2021), and how children handle objects (Schatz et al., 2022). Furthermore, parental input such as object labelling, and features of parent-child interaction such as joint and sustained attention (when parents and children mutually direct their gaze to the same object in the immediate environment; Yu & Smith, 2013) impacts children's vocabulary size (Peters & Yu, 2020). Against this background, the current study examines the quality of parent-child interaction, parent labelling and children's handling of objects when they naturally interact with objects varying in their familiarity to the child. Furthermore, we examine how this quality of interaction influences children's learning of the labels for these objects. In particular, we investigated whether (i) parents lead more instances of joint attention when playing with novel objects relative to familiar ones, (ii) parents preferentially label novel objects relative to familiar objects and (iii) children's learning of novel word-object associations is affected by the frequency of object labelling and children's sustained attention towards the objects. To test these predictions, we recruited 20 parent-child dyads (age range of children: 14-23 months old), who were asked to play with four different toys – two familiar and two novel to the children (but familiar to the parents) – as we examined their eye-movements and labelling behaviour during the play phase. Following that, we tested children's recognition of the labelled novel objects. Data collection is complete and data coding and analysis is currently ongoing. We predict (i) more instances of parent-led joint attention and (ii) a higher frequency of object labelling behaviour during novel object play compared to familiar object play. Furthermore, we predict that (iii) children will show improved recognition of novel toys if these toys were frequently labelled when they were attending to the toys. Such findings would highlight how the quality of social interaction between caregivers and infants is influenced by the objects in their natural environment, which in turn shapes learning.

B28 Associations between attention to the articulating mouth and vocabulary skills in toddlerhood: Does language familiarity still matter?

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Increased mouth-looking in infancy benefits vocabulary skills in the second postnatal year¹. However, whether it remains a supportive mechanism during toddlerhood is unknown. It has been hypothesized that redeployment of attention to the mouth in this period facilitates the acquisition of first-words², but no data support this yet. The only published study found no association between mouth-looking and productive vocabulary at 18 months², perhaps because toddlers may need a protracted time to benefit from visual speech cues.

Language familiarity drives the trajectory of mouth-looking in infancy. It is still unknown whether increased mouth-looking as a facilitator of acquiring new words is also driven by prior language familiarity in toddlerhood or if, instead, it boosts vocabulary acquisition regardless of language familiarity. Infants attend to the mouth for longer in development in non-native vs. native speech, presumably seeking additional phonemic visual speech cues¹. However, at this advanced stage of language expertise, toddlers' seeking visual cues relevant to boost their word learning might be useful only in their native language.

This study investigates whether mouth-looking supports vocabulary skills during toddlerhood and whether such an association is driven by language familiarity. We explore within-subject relations between attention to the articulating mouth—in native and non-native languages—and receptive and productive vocabulary skills at two key ages of the vocabulary spurt (18 and 24 months). We predict that toddlers with increased preference for the mouth will show better vocabulary skills at 24 but not at 18 months. At 24 months, mouth-looking in the native language only will be positively associated with vocabulary skills.

Polish and Norwegian monolingual toddlers are being cross-sectionally assessed in two labs ($n=47$, currently) with an eye-tracking task of selective attention to audio-visual speech—native and non-native—and a parent-report vocabulary inventory.

LCICD 2023

Correlations between the proportion of total looking time to the mouth and words said/understood by age group will be run. We will analyse our data (expected $n=56$; $n=28$ by age group) after pre-registration (ongoing). The results of our study will contribute to better understanding the role of mouth-looking in toddlerhood.

B29 The role of dialect variability on mispronunciation sensitivity: An insight to infants' early language development from a Norwegian context

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Decades of research have highlighted both the differences and commonalities between monolingual and multilingual language acquisition. Yet, substantial differences in the learning environments of monolingual children can modulate learning trajectories towards mature language use. The present study, run as a registered report, investigated one of the major sources of such differences within monolingual language learning: dialectal variability. Durrant et al. (2015) have shown that dialectal differences have an impact on language acquisition; 20-month-old English infants receiving bidialectal input failed to detect word mispronunciations, a skill mastered by their monodialectal peers. However, the lack of research with younger infants and in other languages has left a gap in our knowledge of lexical category development.

In the present study, we recruited 13-month-old Norwegian-learning infants from the Oslo area, from the National Registry. The sample size was determined using a Sequential Bayesian testing paradigm, resulting in a total of 99 participants; 62 infants were raised in monodialectal households (both parents speaking the local Eastern dialect) and 25 in bidialectal households (parents speaking the Eastern dialect and a different type of Norwegian dialect).

Participants were tested with an EyeLink eye-tracker on a mispronunciation task. Stimuli were eight familiar words chosen and presented in two conditions: correct and with a two-feature onset-consonant mispronunciation. This resulted in sixteen different trials, which were presented twice pseudo-randomly for a total of thirty-two trials, along with two neutral trials used to exclude non-engaged participants. Infants were presented with pictures and matching word labels that were either correctly pronounced or mispronounced. The outcome measure was a baseline-corrected proportion of target looking, computed by subtracting the proportion of looking time at the target pre-naming from the proportion of looking time at the target post-naming. Greater proportion of target looks post-naming suggested comprehension in correctly pronounced trials, and a significantly smaller proportion of target looks in the mispronunciation trials compared to correctly pronounced trials post-naming suggested mispronunciation sensitivity.

Results from Sequential Bayes Factor analyses revealed that monodialectal infants exhibited word comprehension (BF= 30.965, after running the maximal number of participants as per the preregistration) yet only anecdotal evidence for

mispronunciation sensitivity (BF= 0.519), whereas bidialectal infants exhibited both word comprehension (BF=7.390, inference reached after just 25 participants) as well as mispronunciation sensitivity (BF= 19.105). These results suggest that lexical categories in Norwegian infants exposed to multiple native dialects appear to be more robust than that of their monodialectal peers.

B30 Measuring parental repetitions of multilingual parents using a moving window analysis

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Parental self-repetitions may enhance children's language learning by scaffolding words and structures over time (Goldstein et al., 2010; Waterfall et al., 2010). These 'variation sets' can be defined as repetition from one utterance to another, or repetition within a given span of words, after removing extremely high-frequency 'stopwords' (e.g., 'the', 'in'; Brodsky et al., 2007; Waterfall, 2006). Parental repetitions have been measured in monolingual speakers, and in multilingual speakers using just one of their languages at a time (Tal & Arnon, 2021, Lester et al., 2022). Challenges for analysing multilingual translanguaged speech include how to implement 'stopwords' across diverse languages.

Methods: In the micro-longitudinal Talk Together Study (Woon et al., 2021), Singaporean parents (N = 146) narrated an on-screen wordless picturebook (Styles, 2021) to their children over three timepoints (total N = 415). Parents were asked to use any language or mix typical for use with their child (Age at first timepoint: Median=1;6, Range = 0;8 to 3;4). In this paper, we adapt a moving-window method (Li & Onnis, 2021) which searches for repetitions of a word within a span (e.g., 10 words) regardless of utterance boundaries. To identify an optimal stable measurement, we explore how number and diversity of repetitions change with different span sizes in the corpus of English, Mandarin, Malay and Tamil child-directed speech. With the moving-window analysis, we compute proportion of repetitions and lexical diversity (HD-D: McCarthy & Jarvis, 2010) of repeated words in every span from 1 (e.g., leaf leaf) to 40 (e.g., leaf —38 words— leaf), with and without stopwords.

Results: As span size increases, the proportion of words repeated and the lexical diversity of repeated words increase, with large increases at short spans (1 to 10) and small increases at long spans (20 to 40). We identify a practical inflection point around the rolling window of 20 to 25 words at which proportion of words repeated stabilises. Age does not predict the proportion of words repeated ($r(144) = -0.021$, $p = 0.8$), but does predict the lexical diversity of repetitions ($r(144) = 0.33$, $p < 0.00001$). When high frequency words are not 'stopped', the age effect is smaller ($r(144) = 0.2$, $p = .017$).

Conclusions: In multilingual speech contexts, parents scaffold vocabulary learning with a wider range of repetitions with older children. We compare different methods

of measuring parental repetitions in diverse language samples and provide open access to the moving-window analysis pipeline.

B31 Measuring child-directed MLU in a multilingual translanguaging community

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Mean length utterance (MLU) is a common measure of syntactic complexity in studies of parent-child interactions, children's language development and in the diagnosis of children's speech disorders. Since Brown (1973), MLU has been operationalised differently by different authors (e.g., morphemes or words; trying to identify the minimum viable amount of speech that needs to be transcribed etc.). Much of the original research was conducted in monolingual English-speaking populations. These measures have been successfully adapted for use in other monolingual populations (e.g., Brazilian Portuguese: Nóro & Mota, 2019; Dutch: Vandewalle et al., 2012, etc.). However, applying these metrics in multilingual translanguaging populations is more complex. Some researchers exclude from computation all code-switched utterances (e.g., Bedore et al., 2010; Yow et al., 2017), which may systematically over- or underestimate the true complexity of multilingual speech. This paper explores measurement characteristics of MLU-like metrics in a large corpus of child-directed speech from multilingual Singapore (languages included in sample: English, Mandarin, Malay).

Methods: Spontaneous child-directed speech was elicited using a wordless picture book ('What A Scary Storm', Styles, 2020) in the micro-longitudinal Talk Together Study (N = 146, over three timepoints; Woon et al., 2021). To test out different measurement parameters, a stratified subsample of twenty transcripts was selected (age: 10 to 34 months old). We compare nine MLU-like measures and discuss which measures show the best fit to the underlying structure of the subsample. Metrics were applied to morphemes to enable cross-linguistic comparison across typologically diverse languages.

Results: The distribution of morphemes per utterance is non-normal, with many very-short utterances and few very-long utterances, hence mean length of utterance is a poor measure of central tendency. The underlying distribution is exGaussian: two parameters describe the length of a typical utterance (μ), and the characteristics of unusually long utterances (τ). In our preliminary investigations, both short utterances and unusually long utterances tend to increase in morpheme count with increasing age (μ -LU: $\rho = 0.40$; τ -LU: $\rho = 0.26$, and the proportion of monomorphemic utterances decreases ($\rho = -0.26$), albeit underpowered in this small subsample. The full paper will report the measurement properties as applied to the full corpus of transcriptions at timepoint 1 (N = 146) to provide adequate power (G*Power: Faul, 2009).

Conclusion: We present a decision tree as a reproducible, pre-registerable pathway for deciding which measurement of MLU-like syntactic complexity is best for data of different types.

B32 What are the phonological characteristics of the earliest words produced by Polish children?

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“Mama”, “baba”, “am” or “traktor”, “rajstopy” and “piekarnik”? Even for a person who does not speak Polish, it is rather clear that the first rather than the second of these two wordsets contains words that could be among the first words said by a Polish child. What is special about the earliest words produced by children? In particular, what are the phonological characteristics of the first words said by Polish children? How often do the words begin with a bilabial phoneme? Do these early words typically have two syllables? Do children often tend to repeat one syllable (e.g. say “koko” instead of “ko”)?

We investigate the earliest words produced by Polish monolingual children. The words are collected with a custom mobile app (“StarWords - every word counts”, Mieszkowska et al., 2022) in which parents provide data on their child’s development and enter words and utterances that their child produces. As soon as the child starts to speak, parents are encouraged to enter each new word spoken by the child. The information entered by parents includes the exact word form produced by the child (e.g. “amam!”, “mee”) accompanied by the word meaning (e.g. “food”, “sheep”).

In our talk, we will present the first 50-100 words of 100 children (8,679 words in total). All these words were produced by children aged 0 to 30 months (18 months on average). We will focus on the phonological properties of the words: the number of syllables, the initial phonemes, the phonological structure, and the repetition of syllables. We plan to analyze the data using linear mixed models, with the age of producing the word as a dependent variable, the phonological properties as independent variables, and random intercepts for participants. We expect that words with a simple phonological structure (e.g. CVCV as opposed to CVCC), words with a word-initial bilabial, words containing repetition of a syllable and words composed of two syllables (rather than one syllable or more than two syllables) will be produced earlier in life than other types of words.

B33 Do parents of preschoolers know what words their children know?

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Parents of babies and toddlers (aged up to 18, 24, or sometimes 36 months) tend to know what vocabulary their children understand and produce. This assumption laid behind the development of numerous language versions of MacArthur-Bates CDIs. Providing parents with a list of words and asking them to mark all the items that their children understand/use is a much more efficient (faster and cheaper) way to measure a child's vocabulary size than an indirect assessment performed by a skilled experimenter. However, typically CDIs are used for the assessment of language skills of children aged up to 36 months.

Recently, questionnaires for the assessment of language skills in older children - CDI-III - have been developed for several languages (e.g. Dale et al., 2023). Some authors used other questionnaires (but based on the same idea of parents marking the words known by the child), such as SDDS (Czech; children aged 18 - 42 months; Smolík & Bytešníkova, 2021) or DVAP (English; children aged 24 - 84 months; Libertus et al., 2015).

In our talk, we will present a parental questionnaire based on the items from the Polish version of Cross-Linguistic Lexical Tasks (Haman, Łuniewska & Pomiechowska, 2015; Haman et al., 2022) used for direct assessment of vocabulary in children aged 3;0 to 5;11. In our study, 100 children participated in a direct assessment of vocabulary (word comprehension and word production). One to 28 days after the children were tested in preschool, their parents completed an online questionnaire. In the online questionnaire, the parents were asked to mark (from the list of 128 target items from Polish CLT) all the words that they had ever heard in a spontaneous speech of the child.

In our analyses, we will answer the main research question: do the parents of the tested children know what words their children know? We will first calculate the correlation between the child's score in the CLT and the score estimated by the parent in the questionnaire. Second, we will contrast the child's performance and the parent's responses at the level of individual items. Third, we will verify whether parents systematically under/overestimate the children's lexicon.

We suggest that if the parents are accurate in assessing their children's vocabulary, then the use of parental questionnaires for vocabulary assessment may be prolonged up to the age of school entrance.

B34 Developing a questionnaire on parental knowledge and beliefs about language development and multilingualism

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Child-directed speech plays an essential role in children's language development [1]. Parental knowledge and beliefs about language development influence how they communicate with their children, shaping the quantity and quality of language input [2] and potentially affecting the choice of language in a multilingual context [3].

Researchers need a reliable tool to further explore the role of parental knowledge and beliefs in multilingual development. The aim of our study was to develop a criterion-referenced questionnaire on knowledge and beliefs about early language development, multilingualism, and supportive parental behaviors.

We conducted a comprehensive review of existing tools and literature on parental behaviors that promote language development. Based on the literature review and expert consultations, we constructed an initial pool of 91 items. The selected questions were then pilot tested in an online study with 98 participants (93F and 5M).

Following the results of the pilot study, we eliminated items based on their difficulty, negative impact on Cronbach's Alpha, or redundancy. The resulting questionnaire consists of 31 items, demonstrates moderate difficulty ($M = 1.47$ on a scale of 0-2) and good reliability ($\alpha = 0.825$). It covers key aspects of language development identified in previous research: preverbal communication, communication milestones, input quantity and quality, parentese, multilingualism, child media exposure.

This tool will serve as a valuable resource for researchers and practitioners. Ultimately, our study can inform the development and evaluation of educational interventions to support parents in fostering optimal language development for their children in multilingual contexts.

B35 How do word properties affect early word learning? A study on words from Polish communicative development inventories

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One way of understanding how children develop their vocabularies is to look at the psycholinguistic properties of words that children already know. Previous studies have found that words that are more frequent, concrete, imaginable or associated with babies are acquired earlier (e.g., Braginsky et al., 2019; Hansen, 2017). To investigate the contribution of these properties to early word learning studies combine data coming from children and adults. The aim of the current study is to create a Polish psycholinguistic database and to investigate predictors of early word learning in Polish monolingual children using data from Communicative Development Inventories (CDI). Furthermore, this study extends the analyses presented by Braginsky et al. (2019) to Polish CDI items.

The study includes norming data from the Polish CDI (Words and Gestures and Words and Sentences) consisting of over 3,500 children aged from 8 to 36 months (Smoczyńska et al., 2015). To collect ratings for over 700 CDI items we ask native Polish speakers to rate 100 words in terms of one property – concreteness, babiness, imageability, subjective frequency or subjective age of acquisition. So far we have collected data from 1673 adults. Data collection is in progress until we collect at least 30 ratings for each word. In the next step we will fit a regression model to item-level data from CDI to investigate the contribution of each word property to the age at which children acquire the word. The aim of the poster is to present the development of the psycholinguistic database and initial results of the analyses with Polish CDI data.

This study will allow us to investigate psycholinguistic predictors of early lexical development in a representative sample of Polish monolinguals. The analyses will also enable comparisons with the results presented by Braginsky et al. (2019) for 10 other languages.

B36 Online intervention to support parents in enriching the language environment of their bilingual children from birth

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Rich and diverse input is crucial for children's language development. Parent-directed interventions can improve the quality and quantity of child-directed speech and thereby enhance children's language development in later years[1]. Multilingual children are at risk of limited language input in at least one language, which can affect their language skills from birth. Thus bilingual families are an important target group for parent-directed early interventions[2].

To investigate whether we can improve parental knowledge about (bilingual) language development even before the child is born, we designed a research-based intervention in the form of an on-line workshop for expectant Polish-speaking parents living in Norway. We are currently conducting a preregistered randomized control trial (with an intervention on infant sleep as a control condition), assessing parental knowledge before and after the intervention and following the language development of children born to the families in the experimental and control groups.

We will present the program of the online intervention workshop (6 blocks, covering preverbal communication, communication milestones, input quantity and quality, parentese, bilingualism and child media exposure) and a plan for a series of follow-up assessments of children's language development. Each block of the workshop includes a presentation with research-based information and practical tips, followed by an activity to increase participants' engagement and skills. The intervention program follows the guidelines for effective language interventions[3]: building upon background knowledge, explicitly describing and illustrating content, providing opportunities to actively apply and generalize learned content in real-world contexts, and supporting metacognition throughout the training process. Follow-up assessments include parental reporting via StarWords app[4] and CDIs[5].

B37 Multilingual parenting: Insights from BERTopic modeling of Reddit submissionsKatarzyna Bajkowska¹ and Mikołaj Biesaga²*¹University of Warsaw, Faculty of Psychology, Warsaw, Poland, ²University of Warsaw, The Robert Zajonc Institute for Social Studies, Warsaw, Poland*

Parents play a crucial role in early language experiences, as they are the main providers of language input prior to formal schooling. For example, Rowe[1] showed that individual differences in children's vocabulary ability can be explained by both quantity and quality of the language parents use in early childhood.

In an increasingly interconnected world, many families raise their children in multilingual environments. Such development poses many challenges, particularly regarding a child's limited exposure to each language[2]. Moreover, parents are responsible for establishing a Family Language Policy, which is often subject to conflicting influences, with parents' beliefs on the one hand, and the social situation on the other[3]. Faced with a range of challenges, parents often turn to online communities for support and guidance regarding their children's language development.

In this study, we explored issues raised by parents of multilingual children on Reddit. We focused on submissions from the r/multilingualparenting subreddit. With over 8000 members, it is in the top 10% of the largest communities on Reddit and serves as a platform for exchanging advice and concerns about raising children with more than one language.

Using the Python Reddit API Wrapper (PRAW), we collected 390 submissions. Then, we preprocessed the data and employed BERTopic – a state-of-the-art topic modeling technique – to cluster texts based on their semantic similarity.

Based on the automatic analysis, we were able to distinguish 5 main topics that discuss the perceived challenges and opportunities of multilingual parenting: 1) a child refusing to speak a language, 2) exposing a child to a parent's non-native language, 3) doubts about family language policy, 4) concerns about language delay and 5) daily joys of multilingual parenting.

Our study highlights the value of analysing social media discourse as a platform for parents to express their opinions unconstrained by social norms regarding parenting. It also allows for identifying the rarely discussed needs of these parents. Ultimately, these findings may help practitioners to develop more effective support systems for parents raising multilingual children.

B38 How does the human fetal response to sound and light change over the course of an experimental session?

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The human fetus can perceive the environment in utero and engage with external stimuli. However, it is unclear how fetal engagement changes throughout an experimental period and what the precise duration of their attentional capacity may be. Previous research shows through 4D ultrasound, that the fetus can perform head movements in response to light (Reid et al., 2017); they can also habituate to vibroacoustic stimuli, showing a decrease in heart rate over trials (Leader et al., 1982; Morokuma et al., 2004). These studies do not provide insight into the extent of fetal response throughout the experimental session. Additionally, eye movements may be a more accurate measure of fetal response than the behaviours indexed in previous studies, as they require less effort, occur more rapidly, and may take place more frequently.

In this study, we conducted 100 scans at the Waikato Hospital with fetuses aged between 33-36 weeks gestation. Using 2D ultrasound, we measured the frequency of fetal head movements and eye movements in response to auditory and visual stimuli. We aim to map different fetal response profiles over an 11-minute period. We analysed responses during different experimental conditions; two baseline periods with no manipulation present, and two experimental periods. Data analysis is ongoing following final acquisition of the data.

We predict several possible patterns of responses that represent fetal states such as fatigue and alertness. Understanding these different response patterns is crucial for fetal research as it may allow us to tailor experiments to the capacities of the fetus. Our knowledge related to fetal fatigue and attention span is currently significantly lacking. These findings may guide future study times by producing an average duration of responses and attentional capacities. Understanding normal fetal response patterns may also aid in diagnosing abnormal prenatal behaviour and this may be used to detect early health complications, benefiting parents, the wider community and improving fetal wellbeing.

B39 Preliminary evidence for age-related changes in cardiac interoception from 13 to 21 months of age

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Research with adults shows that interoception, i.e., the perception of bodily sensations, such as heartbeats, is implicated in a range of cognitive and affective processes, including emotion processing (Critchley & Garfinkel, 2017), adaptive decision-making (Dunn et al., 2010) and behavioural inhibition (Rae et al., 2020). Despite this, empirical research on the development of interoception in infancy is lacking. Using a sequential looking paradigm, Maister et al., (2017) found that 5-month-olds could discriminate auditory-visual stimuli moving in or out synchrony with their heartbeats. On average, 5-month-olds looked longer at stimuli presented asynchronously with their heartbeats. These findings suggest that at least some infants show implicit accuracy in perceiving cardiac signals, however, there is considerable variation in infants' performance and the capacity is likely to change throughout development. The present study investigated the development of cardiac interoceptive accuracy at 13- and 21- months of age and assessed whether individual differences related to variation in temperament, caregiver-infant interactional qualities and mirror self-recognition. We followed 62 infants and their caregivers at 13- and 21 months of age. Participants completed the cardiac discrimination task at both visits. At T1, we also assessed patterns of behavioural and physiological synchrony between infants and their parents. At Time 2, we obtained measures of parent-reported child temperament and toddler's performance on the mirror self-recognition task. Contrary to Maister et al.'s (2017) finding with 5-month-olds, preliminary analyses found no significant preference overall for synchronous or asynchronous stimuli at 13 months old or 21 months old, however, on average, infants showed significantly greater visual discrimination between synchronous and asynchronous cardiac stimuli at 13 months, compared to 21 months old. If confirmed, these results suggest age-related changes in cardiac interoception. Data on temperament and mirror-self recognition will also be presented.

B40 Quantitative and longitudinal tracking of infant general movements: A window into the future?

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An international health care challenge is the early identification of infants that go on to develop life-long neurodevelopmental disorders (NDD). Infant general movements (GMs; an early spontaneous movement pattern observed from birth-5 months) have been increasingly associated with subsequent social-communication abilities, with abnormal GMs being evidenced to have negative cascading effects on many cognitive domains. The GM assessment (GMA) is globally recognized as one of the most effective clinical tools to predict ND outcomes; it is noninvasive, highly sensitive, and reliable method for evaluating the quality of the young nervous system. However, the GMA follows an observational protocol that is neither quantitative nor allows for high-frequency longitudinal tracking of infant motor trajectories. Identifying motor-markers requires high-frequency behavioural sampling so that many brief, time-distributed motor-actions can be measured to visualise developmental trajectories; highlighting the windows of interaction, change and plasticity.

Monitoring the unfolding processes of infant GMs, as well as understanding how motor and cognitive development operate as a dynamic and intertwined system, may offer critical early opportunities to identify infants at high-risk for NDD. Infants develop quickly in their first year of life, so capturing change, as well as windows of interaction and plasticity requires tracking spontaneous motor actions over-time. For this to be done easily and non-invasively, I will develop a quantitative measure of GMs using the neurological PRECHTL's GMA, and a methodology to collect data passively in the natural home environment. To do this, a novel coding scheme will be developed to quantify categories of GM quality (e.g., amplitude, frequency, and fluency) in home recorded videos of infants' motor-actions. Datavyu will be utilized for motor coding and analysing the coding scheme.

Aims: Our study has three aims: (1) Translate the qualitative evaluation of the GMA into quantitative measures. (2) Test developmental relationships longitudinally between quality of GMs and subsequent social-communication outcomes.

Methods: To that end, we will longitudinally track the amplitude, frequency and fluency of spontaneous GMs using videos and state-of-the-art wearable technology, and Social-Communication skills during administration of clinical diagnostic adaptive behaviour test batteries. We will encourage parents to send weekly videos in times when their children are awake and active.

Analysis: The Latent Growth Curve Model will be used to establish multifactorial co-development maps which will arise from integrating motor measures and cognitive scores. We will also use unsupervised machine learning to explore linear and non-linear associations between the motor repertoire and the Social-Communication skills.

B41 Relations Among Screen Use at Home, Child Attention Problems, and Executive Function Skills

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Screen-based media devices have become integral to families; parents and children spend considerable time in front of screens (Blackman, 2015; Rideout, 2017). Previous research focusing on the potential effects of screen use in the family indicated that high amount of child screen time, background TV (TV watching as a secondary, not primary, activity of children), technofence (interruptions in parent-child interactions due to mobile device use), and early age of onset of screen use might disrupt children's language, attention, and self-regulation skills (e.g., Barr et al., 2010; Karani et al., 2022; Martin et al., 2012; Nathanson et al., 2014; Sundqvist et al., 2020). Similar to past studies, this study aimed to examine the relations between screen use habits at home and children's attention and executive function (EF) skills. Moreover, this first study investigated how technofence and mealtime TV viewing are linked to children's attention and EF skills.

139 mothers of 4- to 6-year-old children (M(SD)=64.73(6.76) months) participated in the study. Mothers indicated how many hours their children spend with screens and when children first started watching TV. They also rated the frequency of background TV, mealtime TV, and technofence on a 5-point Likert scale from 0 (never) to 4 (always). Attention problems were assessed via the hyperactivity-inattention subscale of the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997). Children's EF skills were measured by Childhood Executive Functioning Inventory (CHEXI; Thorell & Nyberg, 2008). Results showed that child screen time, background TV, mealtime TV, and onset age of TV are not related to child attention problems and EF skills. However, technofence is associated with increased attention problems ($\tau=.19$) and decreased EF skills ($\tau=-.14$).

Contrary to previous studies, child screen time, background TV, and onset age of TV are not linked to child attention and EF skills. Contributing to the previous literature, this study indicates no relation between mealtime TV and child outcomes and that children experiencing more interruptions in parent-child interactions tend to show more attention problems and lower EF skills. Considering the essential role of parent-child interactions on child development (Perrin et al., 2020) and the disruption in the quality of parent-child interactions due to parental mobile device use (e.g., Kirkorian et al., 2009), the study suggests that the potential negative impact of screens on

young children might be mediated by disrupted parent-child interactions due to mobile device use.

B42 Can A Crab Walk in The Air or Walk Through Walls? Impact of Watching Fantastical Content on Young Children's Cognitive Skills

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Watching fantastical (i.e., physically impossible) events has immediate negative effects on young children's executive functions (EFs) (e.g., Li et al., 2020; Lillard et al., 2015), yet the reason for this effect is not completely known. Due to its unexpected and incomprehensible nature, fantastical content might tax higher-order cognitive functions such as EFs. If this hypothesis is true, then negative effects might disappear after a while due to recovering resources and might not extend to less complex cognitive skills. The current experimental study aimed to (1) detect how long the negative effects persist, and (2) examine whether watching fantastical content negatively affects children's other cognitive skills, namely spatial skills. We expected that a 10-minute rest after watching a fantastical cartoon would alleviate any negative impact and watching a fantastical cartoon would disrupt EFs, but not spatial skills.

120 4- to 6-year-old children (M(SD)=66(5.52) months) were randomly assigned to one of the four following conditions: a) immediate testing after watching an 8-min realistic cartoon (Caillou), b) immediate testing after watching an 8-min fantastical cartoon (Sponge Bob), c) delayed testing 10-min after watching the fantastical cartoon, and d) immediate testing after an 8-min free play (control condition). The testing session included EF measures of working memory (Backward Word Span), inhibitory control (Simon Says), and cognitive flexibility (Flexible Item Selection), along with a measure of spatial skills (Mental Transformation).

Prior to testing, groups did not significantly differ from each other in terms of screen time and parent-reported attention, and EF. A nonparametric Kruskal-Wallis test showed that children in the fantastical cartoon-immediate testing condition performed worse in working memory than children in the control condition, ($\chi^2(3)=9.61, p=.022$), with a mean rank of 50.52 and 75.03, respectively. Children's performance in the fantastical cartoon-immediate testing condition (38.97) was lower than the realistic cartoon-immediate testing (64.25), fantastical cartoon-delayed testing (62.55), and control (76.23) conditions, ($\chi^2(3)=18.23, p<.001$). Groups did not differ on cognitive flexibility and mental rotation.

As in previous studies, watching fantastical content had a negative impact on children's EFs (i.e. working memory and inhibitory control), but this negative impact disappeared in a few minutes and seems to be unique to EF skills. These results

suggest that fantastical content may affect attentional and information processing systems related to EFs, which require more controlled activity than the processing of spatial information.

B43 Early language exposure affects face perception in 9-month-old infants raised in a multi-ethnic city

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The other-race effect (ORE) describes the fact that we are more susceptible to recognition errors for faces from an unfamiliar racial group and it develops as early as the first year of life: Whereas 3-month-old infants can still discriminate among faces of different racial groups, this ability decreases in the following months. By 9 months, infants robustly fail to discriminate facial identities unless they belong to the infants' most familiar racial group (Kelly et al., 2007; Sugden & Marquis, 2017).

While the ORE's developmental time course is well understood in infants with predominant exposure to a single-race face category and a single native language (monolinguals), we do not currently know how wider language (bilingualism) and face exposure shape own- and other-race face perception.

We tested 9-month-old monolingual (mean exposure to L1=98%) and bilingual (mean exposure to L2= 30%) infants from the greater London area on a face recognition task with own- and other-race, dynamically moving, silent faces. In addition to recognition ability, we measured selective attention to facial features during habituation and test. Parents were asked to provide detailed information on infants' everyday language and face exposure.

Neither group showed the classic ORE pattern, suggesting that growing up in a multi-ethnic city might attenuate it. Moreover, bilinguals had higher recognition scores than monolinguals in response to both face types, indicating a general face recognition advantage in this population. Analyses of the face scanning data revealed that both groups of infants attended to the eyes most across habituation, but only bilinguals actively increased their attention to the eyes in the course of habituation. Importantly, increased attention to the eyes at habituation was related to higher recognition scores at test across the whole sample. Results are discussed in the context of the wider literature on the effect of bilingual exposure on selective attention to faces as well as the ORE in infancy.

B44 Emergence and transition in the developmental pathways of locomotion in Brazilian infants from 5 to 18 months old

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Locomotion is one hallmark of autonomy. From a dynamic perspective, behavioral patterns are states reached by a system over time whereas the onset of a new state is called emergence, and a transition is the phase shift from one state to another¹. This study characterized emergence and transition and the association between these events in the locomotion development of Brazilian infants from 5 to 18 months old. Remote research with 45 full-term infants divided into age groups (G1: 5 to 11 mo, n=19; G2 9 to 15 mo n=18; G3: 13 to 18 mo, n=8). Parents recorded infants during 7.73 ± 1.21 minutes of free-play at home every 15 days over the 6-month follow-up. Locomotion bouts were coded as: crawling on the belly (BEL); hands-and-knees (CAT); asymmetrical, (ASYM); walking on feet supported (SW) or unsupported (UW). An emergence was registered when a new behavior appeared and a transition when there was a change in the predominance of behaviors observed between videos. The onset of locomotion occurred by BEL, CAT, or ASYM and was significantly sooner for BEL when compared to CAT ($p=0.018$). There were 15 different pathways for the emergence of locomotor behaviors for G1 and 8 for G2. There were 12 different pathways for transition for infants from G1, 13 for G2, and 3 for G3. Infants from G1 that have presented at least 1 event of transition to SW were younger at the emergence of locomotion, CAT, and BEL when compared to those that have not ($p<0.05$). The age of CAT's emergence was associated with the age of the first transition to SW ($p=0.042$, $\rho=0.829$). The lower the age at the emergence of SW, the lower the age at the first transition to the same behavior ($p=0.018$, $\rho=0.421$). The lower the emergence age of UW, the lower the age at the first transition event both to SW ($p=0.011$, $\rho=0.555$) or UW ($p=0.000$, $\rho=0.831$). Transitions between CAT and SW were recurrent until the transition to UW. After any transition event to UW, there were no more transitions. Emergence and transition compose diverse developmental pathways of locomotion of Brazilian infants even in the context of a study conducted during the home quarantine and social restrictions of COVID-pandemic.