Welcome to WILD 2015!

We are very happy that you have decided to attend the second Workshop on Infant Language Development (WILD 2015)! We sincerely hope that you will find the conference inspiring and educational, and that you will have the opportunity both to meet old fellows and make new acquaintances. With the breadth of topics covered by the delegates and the high quality of their research, we expect a fruitful meeting for all and sundry.

Best regards,

The WILD 2015 Organizing Committee

Department of Linguistics

Stockholm University

WILD 2015

WILD 2015

Workshop on
Infant Language Development 2015

June 10-12, 2015 in Stockholm, Sweden

Book of Abstracts

Stockholm University

WORKSHOP ON INFANT LANGUAGE DEVELOPMENT

WILD 2015

JUNE 10 – 12, 2015

STOCKHOLM, SWEDEN

WILD 2015

Time	Wednesday, June 10	Thursday, June 11	Friday, June 12
08.30 - 09.30	**Keynote lecture** Dr. Alejandrina (Alex) Cristia	**Keynote lecture** Prof. Ghislaine Dehaene-Lambertz	**Talk session** Infant speech perception
09.30 - 10.00	**Coffee break**	**Coffee break**	**Coffee break**
10.00 - 11.00	**Talk session** Social factors of language acquisition	**Talk session** Neurodevelopmental aspects of language acquisition	**Talk session** Early language comprehension and lexical development 2
11.00 - 12.00	**Special session** Issues in bilingual language development research	**Keynote lecture** Prof. Angela D. Friederici	**Keynote lecture** Prof. Paula Fikkert
12.00 - 13.00	**Lunch break**	**Lunch break**	**Lunch break**
13.00 - 14.00	**Talk session** Infant speech perception	**Poster session** Neuro, atypical development, cognition, null results	**Special session** Early speech production
14.00 - 15.00	**Keynote lecture** Prof. Linda Polka	**Talk session** Methodological issues in infant language research	**Talk session** Infant-directed speech 1
15.00 - 15.30	**Coffee break**	**Coffee break**	**Coffee break**
15.30 - 16.30	**Poster session** Bilingualism, speech perception, social factors	**Talk session** Modeling infant language development	**Poster session** Speech production, lexical development, IDS
16.30 - 17.30	**Talk session** Early language comprehension and lexical development 1	**Special session** Eye-tracking in infant language research	**Talk session** Infant-directed speech 2

WELCOME TO WILD 2015!

We are very happy that you have decided to attend the second Workshop on Infant Language Development (WILD 2015)! We sincerely hope that you will find the conference inspiring and educational, and that you will have the opportunity to both meet old fellows and make new acquaintances. With the breadth of topics covered by the delegates and the high quality of their research, we expect a fruitful meeting for all and sundry.

We have aspired to keep up the tradition of an interesting conference in a beautiful and enjoyable environment, as started by the organizers of WILD 2013 in San Sebastián, Spain. In that vein, both the conference sessions and the conference dinner will take place at the baroque palace Piperska Muren in the middle of Stockholm. It is located on Kungsholmen, a part of Stockholm with many outdoor restaurants, cafés and bars. Only a short walk away you can find the City Hall, venue for the Nobel Prize Ceremony each year.

Stockholm in June is a spectacular mix of greenery, water, and a population starved of sun after a long, dark winter. Find some time and take a stroll along the Norr Mälarstrand and you will get an unparalleled view of the different islands of Stockholm!

Organizing this conference would of course not have been possible without our funding agencies Vetenskapsrådet and Riksbankens Jubiléumsfond. We would like to thank Francisco Lacerda, Head of the Department of Linguistics, and the Departmental Board for agreeing to host WILD this year. We would also like to thank the administrative staff for their help and support in this undertaking. Special thanks go to Ann Lorentz-Baarman and Linda Habermann, without whom we would have been lost several times over.

Last, but definitely not least, we would like to thank all of you for attending the conference to present your work and/or listen to others.

Best regards,

The WILD 2015 Organizing Committee

Ellen Marklund, Iris-Corinna Schwarz, Elísabet Eir Cortes, Johan Sjons, Ulrika Marklund, Tove Gerholm, Kristina Nilsson Björkenstam, Monika Molnar

ACKNOWLEDGEMENTS

STUDENT TRAVEL AWARD RECIPIENTS

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Shanshan Lou and Katrin Skoruppa

Hanna Elo
Conducting automatic vocalization assessment (AVA) with Finnish twin data
Hanna Elo and Anna-Maija Korpijaakko-Huuhka

Borja Blanco
Brain network activity in 4-month-old-bilingual and monolingual infants
Borja Blanco, Monika Molnar, Manuel Carreiras and Cesar Caballero

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Language acquisition: From the lab to the wild

Alejandrina (Alex) Cristia

Laboratoire de Sciences Cognitives et Psycholinguistique, Paris, France

Children go from speechless beings to conversational partners in just a few years. This everyday miracle has been studied with strikingly diverse approaches, such as:

1) Analyzing corpora to capture the input;

2) Building artificial languages to isolate learning mechanisms; and

3) Using experiments and corpora to measure progress.

But to explain how language acquisition happens in the real world (in poor and rich households, in mono- and multi-lingual environments, in every human culture), we need an approach that combines insights from all three. For instance, individual and cultural variation may provide us with "natural experiments" that shed light on how input and learning mechanisms interact in actual language acquisition.

In collaboration with colleagues from my lab and beyond, I am attempting to gather data on such natural experiments using insights from laboratory studies. This talk aims to inform listeners of some interesting results (e.g., talker variation is helpful in the lab, but has variable effects in real life), provide useful tips (such as which experimental paradigms to adopt for higher test-retest reliability), and discuss how the field could advance more quickly in the enterprise of figuring out how infants learn language in the wild.

Silent no more… Bringing infant speech into the speech perception lab

Linda Polka

School of Communication Sciences and Disorders, McGill University, Canada

Over the past four decades we have learned a great deal about how infants perceive and decode the speech input around them and directed to them. Yet we know very little about how infants perceive their own vocalizations or speech with the unique vocal properties of an infant talker. This leaves a serious gap in our understanding of infant language development. In this talk I will present findings from a new line of research that begins to address this neglected aspect of infant speech development by exploring how infants perceive speech with infant vocal properties. To accomplish this we used the Variable Linear Articulatory Model (VLAM) to create vowel sounds that conform to talkers across a wide age including a 6-month-old infant. We tested pre-babbling infants to learn how babies respond to infant speech sounds before they are competent speech producers with ready access to infant speech sounds. I will present findings from vowel categorization and listening preference experiments which provide new insights into the perceptual resources that guide infant speech development. I will also outline some new research directions emerging from our initial work that promise to open up our understanding of interactions between perception and production in early development.

Neural constraints on language acquisition in infants

Ghislaine Dehaene-Lambertz

INSERM U992, Neurospin/CEA, Paris, France

Although different human languages use different sounds, words and syntax, most children acquire their native language without difficulties following the same developmental path. Once adults, they use the same specialized networks, located primarily in the left hemisphere around the sylvian fissure, to process speech. Thanks to the development of brain imaging, we can now study the early functional brain organization and examine on which cerebral resources (i.e. the computational properties made available by the activated neural networks) infants rely to learn their native language. I will discuss how results obtained during the first months of life with functional magnetic resonance imaging (fMRI) and event-related potentials (ERPs) might shed light on the emergence of language in the human species.

Neural basis of language development

Angela D. Friederici

Max Planck Institute for Human Cognitive and Brain Sciences, Department of Neuropsychology, Leipzig, Germany

Language develops as the brain matures. Newborns demonstrate impressive abilities in phonological learning. From very early on their behavior is already tuned towards their mother tongue (Mampe et al., 2009). Perceptually based word learning starts at the age of 3 months and by the age of 5 months infants are able to learn phonologically coded syntactic nonadjacent dependencies (Friederici et al., 2012). Although such phonologically based learning is present in the first months of life, it takes a long time before structurally complex sentences can be processed. It will be shown that the maturation of certain brain structures goes together with the development of particular processing abilities. In adults the language-related brain regions in the frontal and temporal cortex are connected via several fiber tracts ventrally and dorsally. Ventrally located fiber tracts which connect the semantic regions in the inferior frontal and temporal cortices are taken to constitute part of the semantic processing system. Dorsally there are two tracts: one pathway which connects the temporal cortex to the premotor cortex (PMC) assumed to support auditory-based phonological processes and another pathway which connects the temporal cortex to Broca's area (BA 44), a region known to subserve the processing of syntactically complex sentences. Brain structural data from newborns, children and adults demonstrate that the ventral connection supporting semantic processes is fully matured at birth (Perani et al., 2011). This is interesting as word learning is shown to start during the first months of life. The two dorsal pathways, however, have different developmental trajectories. The pathway to PMC is mature at birth and may provide the bases for phonologically based learning observable early during development. The pathway to BA 44, however, only matures much later. It will be shown that the maturation of this pathway is directly linked to the performance of processing of syntactically complex sentences across development (Skeide et al., in press). Thus it appears that certain milestones in language development can only be achieved once particular brain structures are fully matured.

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Is the devil in the detail?
Abstract and detailed representations in perception and production

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Children learn to recognize words fast and reliably despite noise and variation in the input. They do this by extracting relevant phonetic features from the input and matching these onto phonological representations of words stored in the mind. How they learn to do this? Over the last four decades we have learned that infants are amazingly good at **phonetic learning**. However, our understanding of what happens when children construct their mental lexicon, which requires **phonological learning**, is as yet poor.

Phonological learning involves the construction of invariant phonological representations of words that are both abstract enough to allow fast recognition and handle phonetic, phonological and morphological variation automatically, and detailed enough to keep lexical items distinct. Moreover, these same phonological representations are used to initiate articulation for production.

In this talk I will argue that a comprehensive theory of phonological acquisition should take both perception and production into account, as well as learning and development. I will present a large set of production and perception data addressing the nature of place and manner of articulation as well as laryngeal features. For each set of features asymmetries in children's perception and production are attested. However, the asymmetries do not allow for one straightforward explanation, and are motivated differently for each set. I will discuss the consequences for a model of phonological acquisition. Most data will come from Dutch, but data from other languages, including German, English and Japanese, will be presented as well.

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Social factors of language acquisition

Talk session
Wednesday, June 10, 10.00
Chair: Tove Gerholm

Variation in expressive vocabulary size of Estonian children

Tiia Tulviste

University of Tartu, Tartu

The study explored the size of expressive vocabulary of Estonian children, and the effect of gender, age, family factors, and attending kindergarten on it. The study was based on data from Estonian version of the MacArthur-Bates Communicative Development Inventories (ECDI Toddler Form) on 1235 children aged 16 to 30 months. Results showed huge variation in size of early expressive vocabulary. The older the children were the more they were reported to produce words. At each age, girls had consistently larger vocabularies than boys. Gender differences were present in those children who attend the kindergarten, but not in children who were not. It is likely that girls benefit from going to kindergarten more than boys. The size of vocabulary of firstborn children was statistically not bigger from those of children born later. Language gap between children of more highly educated (with at least secondary education) and less educated mothers and fathers emerged at age of 29 months.

Twelve-month-olds differentiate between typical and atypical turn timing in conversation

Elma Hilbrink[1], Marisa Casillas[1] and Imme Lammertink[2]

[1]*Max Planck Institute for Psycholinguistics, Netherlands;* [2]*Radboud University, Netherlands*

Conversation is children's source for linguistic input, and their context for language production. Recent studies on conversation have established that the timing of turns is a fundamental resource for coordination in interaction (Levinson, 2006). Children's sensitivity to timing begins developing in early infancy (Bateson, 1975); mother-infant interactions suggest that timing development begins around 3–4 months (Hilbrink et al, under review), and 3-month-olds sense a 1-second delay in interaction (Striano et al, 2006). But there is currently no direct evidence bearing on when children start to understand the rules for conversational timing or what types of timing patterns they can distinguish.

We showed ten 12-month-olds videos of conversation featuring a trio of puppets (A–B–C) that were paired into two dyads (A–B and B–C). Two puppets (A and B) used typical turn timing (200ms inter-turn silence), and the third used atypical timing (1200ms inter-turn silence or 3+ syllables vocal overlap). After showing the videos, we took two measures of children's puppet-timing preference. First, children gazed at a 30-second image of two puppets (A–typical and C–atypical). Second, the experimenter held out two real-life puppets (A and C) for children to choose between.

Preliminary results based on ten sessions suggest that 12-month-olds detected a difference between the puppets' timing and had a strong preference for atypical (novel) timing styles. When viewing the pair of puppets on screen, 75% of children's first looks and 46.4% of their total gaze in the first 10 seconds went toward the atypical puppet (total gaze also includes looks to the typical puppet: 39.7% and areas off-screen: 13.8%). Also, 7 of the 7 children who reached for a real-life puppet grabbed the atypical puppet. These findings support the idea that sensitivity to turn timing develops in infancy, and that children's implicit knowledge about conversation might already be somewhat sophisticated at 12 months.

Development of turn taking in vocal interaction between mothers and infants aged between 2 and 4 months

Maya Gratier[1], Emmanuel Devouche[2], Bahia Guellai[1], Infanti Rubia[3], Ebru Yilmaz[1] and Erika Parlato-Oliveira[4]

[1]Université Paris Ouest La Défense, France; [2]Université Paris Descartes, France;[3]Université Paris Ouest Nanterre La Défense, France; [4]Universidade Federal de Minas Gerais, Brazil

Infants are known to engage in conversation-like exchanges from the end of the second month after birth. These protoconversations involve both turn-taking and overlapping vocalization. Previous research has shown that the timing of adult-infant turn-taking sequences is close to that of adult verbal conversation. The gap between turns in protoconversational exchange seldom exceeds 500ms. It has also been shown that young infants adjust the quality of their vocalization in response to the quality and timing of adult vocalization. Furthermore, turn-taking exchanges often involve mutual imitation of sounds, pitches and melodic contour. We present new evidence of the timing and temporal organization of turn-taking interaction between mothers and 2 to 4-month-olds recorded in naturalistic contexts based on a corpus of recordings from 50 French dyads. The entire sample comprised a total of 2943 vocalizations of which 748 (25.4%) were produced by the infants, 1851 (62.9%) were produced by the mothers, and 344 were overlapping vocalizations (11.7%). In all, 489 turns taking sequences were identified. The quality and duration of infant vocalizations differed according to whether or not they were produced within a turn-taking sequence. Finally, length and number of turns were highly correlated between mothers and infants vocalizations.

Infant speech perception

Talk session

Wednesday, June 10, 13.00

Chair: Jean-Luc Schwartz

English-learning infants' knowledge of vowel phonotactics

Katrin Skoruppa[1], Claire Delle Luche[2], Laurence White[2] and Caroline Floccia[2]

[1] Universitaet Basel, Switzerland; [2] Plymouth University, UK

During the first year of life, infants start to understand how native sounds can be combined to form words. By nine months, English-learning infants react to the frequency of consonant sequences, and can use this knowledge for word segmentation. However, little is known about whether, and when, they become sensitive to phonotactic restrictions regarding vowels. These questions are particularly pertinent given current debates over the roles of consonants and vowels in early lexical processing.

In three headturn preference studies, we investigated English nine-month-olds' sensitivity to the lax vowel constraint, i.e. the fact that typical English words do not end in a lax vowel (e.g. [*tɑːmɒ], except for schwa). In each experiment, 20 infants listened to 12 lists of pseudo-words.

In Experiment 1, using disyllabic CVCV pseudo-words, infants listened longer to words ending with an illegal lax vowel (e.g. [ˈtɑːmɒ]) than to words ending in a legal tense vowel (here, [ˈmɒtɑː], two-tailed t-test: p=.015). In Experiment 2, using monosyllabic CV pseudo-words, infants preferred legal tense vowels (e.g. [ruː]) over illegal lax vowels (here, [rʊ], p=.049). Finally, in Experiment 3 with monosyllabic CVC pseudo-words, infants showed no preference for word-medial lax (e.g. [ruːz]) or tense vowels (here, [rʊz], n.s.). This control experiment indicates that infants' behaviour in Experiment 2 cannot be interpreted as a general, position-unspecific, preference for tense over lax vowels.

Taken together, these results strongly suggest that infants are sensitive to the English lax vowel constraint at nine months. We will discuss the influence of prosody and task demands on the directions of our effects, how our results impact on theories of the developmental significance of vowels vs consonants, and present pilot work with first signs of sensitivity to vowel phonotactics at 6 months, considerably earlier than previously documented for consonant phonotactics.

Perception of Mandarin lexical tone in English adults and young infants

Shanshan Lou[1] and Katrin Skoruppa[2]

[1]*Department of Language and Linguistic Science, University of York, UK;* [2]*Departement Sprach- und Literaturwissenschaften, Universität Basel, Switzerland*

Previous research on tone perception by listeners of non-tonal languages document a initial sensitivity to tone contrasts early in infancy, which starts to decline during the second half of the first year of life (Mattock & Burnham, 2006; Mattock et al., 2008). However, these studies only used segmentally identical syllables ([ba] with rising vs. [ba] with falling tone). Studies on stress, another prosodic dimension, have shown that segmental variability plays a crucial role in infants' early discrimination abilities (Skoruppa et al., 2009; 2013), with infants of all language backgrounds succeeding on an acoustic level without segmental variability (['pima 'pima…] vs. [pi'ma pi'ma…]) but failing on a more abstract, phonological level with segmental variability (['luma 'kivu…] vs. [pi'ma lu'ta…])at 6 months.

This study examines the processing of Mandarin lexical tones (high levek vs. low rising) in English and Mandarin adult speakers (n=12 each) in a tone sequence recall task; and in 4- to 6-month-old English-learning infants (n=10) in a visual fixation task. We use CV(C) stimuli with and without segmental variation in a within-subject design, in order to assess whether phonological variability interplays with language-specific experience. English adult listeners experience great difficulties with processing tone contrasts in structures with segmental variability ([ga be…] level vs. [ha lin…] rising), at an abstract, phonological level. However, their performances are as good as the Mandarin listeners in the absence of segmental variability ([dun dun…] level vs. [dun dun…] rising), indicating that they can perceive the acoustic correlates of these tones. Surprisingly, and contrary to the findings for stress, English infants successfully distinguish the tone patterns of non-words in both segmentally identical and varied stimuli. We discuss differences between tones and stress, and the possible influence of acoustic distinctiveness on infant's perceptual sensitivity.

On the edge of language acquisition: Inherent constraints on encoding multisyllabic sequences in the neonate brain

Alissa Ferry, Ana Fló, Perrine Brusini, Marina Nespor and Jacques Mehler

SISSA, Italy

To understand language, humans must encode information from rapid, sequential streams of syllables— tracking their order and organizing them into words, phrases, and sentences. In two experiments, we used functional Near-Infrared Spectroscopy (fNIRS) to determine whether human neonates are born with the capacity to track the positions of syllables in multisyllabic sequences. Experiment 1 showed that, after familiarization with a six-syllable sequence (e.g., simebutalɛfo), neonates detected the change (as shown by an increased in oxy-hemoglobin) when the two edge syllables switched positions (e.g., fomebutalɛsi) but not when two middle syllables switched positions (simetabulɛfo). These findings indicate that newborns encoded the syllables at the edges of sequences better than those in the middle. Moreover, when a 25ms pause was inserted between the middle syllables (e.g. simebu_talɛfo) as a segmentation cue, neonates detected the change when the middle syllables switched positions (Experiment 2). The results from Experiment 2 suggest that subtle cues in speech can signal a boundary, with enhanced encoding of the syllables located at the edge of that boundary. These two experiments suggest that from birth, the encoding of multisyllabic sequences is constrained, with subtle segmentation cues in the speech stream providing a mechanism to accurately encode positional information from longer sequences. The ability to precisely encode identity and position of syllables in multisyllabic sequences is necessary to track the hierarchical organization of syllables into words, phrases, and sentences. Our results suggest that the foundations for encoding this information are present in humans from birth.

Early language comprehension and lexical development 1

Talk session

Wednesday, June 10, 16.30

Chair: Eva Berglund

The role of consonants and vowels in 5- and 8-month-old own name recognition: Implications for lexical development

Katie Von Holzen[1] and Thierry Nazzi[2]

[1]Université Paris Descartes, Sorbonne Paris Cité, France; [2]Université Paris Descartes, Sorbonne Paris Cité; CNRS – Laboratoire de Psychologie de la Perception (UMR 8242), France

French-speaking adults (see New & Nazzi, 2014) and French-learning toddlers (see Havy & Nazzi, 2009; Poltrock & Nazzi, in press) give more weight to consonantal than vocalic information during lexical processing, demonstrating a consistent C-bias from 11 months onward in this language. However, recent studies demonstrate a vowel- (V-) bias for name recognition at 5 months (Bouchon et al., 2014) and word segmentation at 6 months, but a C-bias for segmentation by 8 months (Nishibayashi & Nazzi, in prep), suggesting a developing C bias. Here, we further investigate the development of the C-bias and its implications for later language development.

Experiments 1 and 2 tested 5- (n = 16) and 8-month-old (n = 13) French-learning infants on their preference for a C or V mispronunciation (misp; 1 feature phonetic change) of their name. Based on previous results, a preference for the C-misp would indicate a V-bias, while a preference for the V-misp would indicate a C-bias. Thus far, 5-month-olds show no preference in this conflict paradigm between C- (9.70 s) and V-misps (10.21 s), while 8-month-olds show a significant preference for C- (9.72 s) over V-misps (8.30 s), $t(12) = 2.11$, $p = .05$, indicating a V-bias at 8 months.

One possible explanation for a lack of a preference at 5 months is that only misps were presented: Both Bouchon et al. and Nishibayashi and Nazzi included correct pronunciations of words as well as misps in their experimental design. Ongoing experiments replicate Experiments 1 and 2, but begin with 20 correct repetitions of the infant's name, providing a perceptual anchor. In addition, we also collect vocabulary scores for 8-month-olds since one hypothesis linking the C-bias to the structure of the lexicon (Keidel et al., 2007) predicts a correlation between C-bias and vocabulary size. Vocabulary measurements are also planned at 13 months to explore whether the magnitude of a C- or V- bias at 8 months is related to later vocabulary development.

Infants' encoding of phonological detail during cross-situational word learning

Paola Escudero[1], Karen Mulak[1] and Haley Vlach[2]

[1]*University of Western Sydney, Australia;* [2]*University of California, Los Angeles, USA*

Infants can track co-occurrences of novel words and referents across situations to learn phonologically distinct words. However, it is unknown whether they can encode fine phonemic distinctions during cross-situational word learning.

We investigated 92, 12-19.5 month-old infants' ability to learn words presented in consonant minimal pairs (BON-DON), vowel minimal pairs (DEET-DIT) and non-minimal pairs (TON-DUT). ConsMPs differed in place, voicing, or place+voicing, and vowelMPs differed in height, backness, or height+backnes. Infants were first presented with 36 learning trials with novel images and words. They then completed preferential looking test trials where they saw two images and repeatedly heard the name for one of the images.

We analysed performance accuracy (looking time to target) for the first word repetition in a trial. An ANOVA with pair type, condition, and age group revealed an interaction pair type x condition, $F(4, 160) = 12.01$, $p < .001$, $\eta p2 = .231$. Accuracy for consMPs differing in place was below chance, $p = .001$, and was lower than for those differing in voicing, $p < .001$, or place+voicing, $p = .001$. Accuracy for vowelMPs differing in height+backness was above chance, $p < .001$ and was greater than backness only, $p < .001$, and height only, $p = .018$. Accuracy for nonMPs was above chance, $p = .044$.

Interestingly, test performance was predicted by the total amount of fixation to each image during the learning phase, as infants who looked less at the images during learning had higher accuracy during the test phase. , $b = -0.018$, $t(91) = -4.15$, $R2 = 0.16$, $F(1, 91) = 17.20$, $p < .001$. This suggests that longer looking times during learning maybe associated to processing difficulty.

Our research shows that infants can encode some phonological detail in cross-situational word learning. However, performance depends on the type/number of phonological differences and on the speed at which infants can process word-referent pairings during learning.

Testing the scope of cross-situational learning: Auditory context and retention

Caroline Junge[1], Pralle Kriengwatana[2], Paola Escudero[3] and Maartje Raijmakers[4]

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Cross-situational word learning (XSL) is proposed as a key statistical learning mechanism by which infants and children learn new words: the more often a word and referent occur together across different situations, the more likely they belong together. Thus, XSL allows children to decipher which words correspond to which referents without explicit explanations of word-referent mappings, and when many unknown words and possible referents are encountered simultaneously. Since the first demonstration of infants' ability to learn words in this paradigm (Smith & Yu, 2008), recent studies indicate that task manipulations such as order of introduction might impede infants word learning (e.g., Vlach & Johnson, 2013). Indeed, infants' natural learning environment appear far from optimal: most words are produced in utterances, and word-object repetitions are often far apart, taxing infants' memory spans. We here report two other manipulations to test XSL in 18-month-olds: word context, and delay between learning and test.

Experiment 1 examines whether presenting words in carrier sentences rather than in isolation affects word learning. On the one hand, this might impede learning, because infants need to first segment words before they can map them to objects. On the other hand, typical naming-sentences might highlight the learning situation. Results show a main effect of Learning ($F_{47}=4.1$, $p<.05$), but no interaction of Context x Learning ($F_{47}<1$, $p=.52$).

Experiment 2 tests whether infants can retain their word learning. We will use Smith & Yu's (2008) procedures with isolated words, and where memory of words is tested immediately after learning. We will compare this to when memory is tested 5-min after learning. Together, these results will inform us about the plausibility that infants use XSL in daily life and will be crucial for establishing whether XSL is truly a feasible word learning mechanism.

Neurodevelopmental factors of language acquisition

Talk session

Thursday, June 11, 10.00

Chair: Lisa Gustavsson

Predictive coding mediates word recognition and learning from the early stages of language development

Sari Ylinen, Alexis Bosseler, Katja Junttila and Minna Huotilainen

University of Helsinki, Finland

The ability to predict future events in the environment and learn from them is a fundamental component of adaptive behavior across species. Predictive coding promotes reward-based associative learning in non-human animals, whereas in humans it also serves more complex cognitive functions, including language. Here we propose that the domain-general mechanism of inferring predictions about future events is crucial to speech processing and word learning in children. Twelve- and 24-month olds' (N=24) electrophysiological brain responses to heard syllables are faster and more robust when the preceding word context predicts the ending of a familiar word. For unfamiliar, novel word forms, however, word-expectancy violation generates a prediction error response, the strength of which significantly correlates with children's vocabulary scores at 12 months. These results suggest that predictive coding serves as the neural mechanism for both word recognition and early learning of novel words. We argue that early language development is guided by the same prediction-based learning mechanism reported across domains in human and non-human animals.

Brain network activity in 4-month-old bilingual and monolingual infants

Borja Blanco, Monika Molnar, Manuel Carreiras and Cesar Caballero

Basque Center on Cognition, Brain and Language, Spain

The language and auditory networks are two of the functional brain networks with fastest development during the first months of life (Dubois et al., 2014, Gao et al., 2014). Because it has been previously observed that different brain regions are involved during speech processing across monolingual and bilingual 4-month-old infants (Molnar et al., 2014), it is a possibility that bilingual exposure, as a long-term environmental factor, affect the developing language neural circuitry. Also, it has been previously proposed that frontal and temporal functional networks play a relevant role in speech perception development already at 4 months of age (Homae et al., 2010). In this work, we investigate how synchronized spontaneous activity of spatially distant areas in the infant brain during resting state, as a measure of functional connectivity, is modulated by early exposure to one versus two languages. We used a 52-channel near-infrared spectroscopy system to measure spontaneous brain activity in 4-month-old Spanish monolingual (n=12) and Basque-Spanish bilingual (n=12) infants. Functional connectivity was evaluated by computing the correlation between the time courses of the oxy-, deoxy- and total hemoglobin signals at each channel for each infant. Network metrics of intrahemispheric and interhemispheric connectivity were evaluated to reveal potential differences in the connectivity patterns between groups. Overall, our findings suggest that early and continued exposure to a bilingual environment affects the configuration and the development of resting state functional brain networks, as it requires the engagement of additional brain regions (particularly bilateral frontal and temporal regions).

The acquisition of native assimilation rules: Evidence from event-related potentials

Mathilde Fort[1], Perrine Brusini[2], Maria Julia Carbajal[3], Ghislaine Dehaene-Lambertz[4] and Sharon Peperkamp[3]

[1]*Universitat Pompeu Fabra, Center for Brain and Cognition, Spain;* [2]*Scuola Internazionale Superiore di Studi Avanzati (SISSA), Language, Cognition and Development Lab, Italy;* [3]*Ecole Normale Supérieure, Laboratoire de Sciences Cognitives et Psycholinguistique, France;* [4]*INSERM and LPPS, Neurospin, France*

In French, voiceless obstruents can become voiced if and only if they are followed by a voiced obstruent. For instance, oeuf dur ("hard-boiled egg") can be pronounced oeu[vd]ur (but oeuf noir "black egg" cannot be pronounced oeu[vn]oir). French 24-month-olds have acquired this voicing assimilation rule: like adults, they compensate for assimilation-induced voicing changes to retrieve the intended words (Skoruppa et al., 2013). We investigate whether younger infants likewise compensate for voicing assimilation.

We tested 14-month-old French-learning infants, who have acquired their native phonological categories but do not know many words yet. We collected EEG measures using a mismatch paradigm with pseudo-words. In each trial, a series of four identical precursor stimuli was followed by a test stimulus that was either identical (Same) to the precursors or differed from them in voicing of the first consonant (Voicing Change). In the Legal condition, the precursor stimuli presented the context for assimilation (e.g., precursor: [ofde], test: [ovde] – [d] can induce the rule); in the Illegal condition, it did not (e.g., precursor: [ofne], test: [ovne] – [n] cannot induce the rule). Previous results with this paradigm have shown that due to perceptual compensation, French adults detect this phonological variation and show a mismatch negativity response in the Illegal but not in the legal condition (Sun et al., submitted). In the present study, infants (N=35) similarly showed a MMN for Voicing Change in a 300-400 ms time window after the onset of the critical consonant in the Illegal condition, $t(1,34) = 2.43$, $p < .05$, but not in the Legal one ($t < 1$).

Data collection is still underway, but the present results strongly suggest that 14.5-month-old French infants already compensate for native voicing assimilation. Since their lexicon is very small at this age, they might rely on a distributional acquisition mechanism rather than on a lexical one (Peperkamp, 2003).

Methodological issues
in infant language research

Talk session

Thursday, June 11, 14.00

Chair: Iris-Corinna Schwarz

Using dynamic assessment to explore early risk markers for communication difficulties

Helen Cain, Nicola Botting and Natalie Hasson

City University London, UK

Background: Recent work has established that dynamic assessment (DA) is a useful tool for language research and therapy (e.g. Hasson, Camilleri, Jones, Smith and Dodd, 2012). This methodology has been cited as particularly useful for client groups who are harder to assess using standardised procedures, such as bilingual children or those with Autism Spectrum Disorders. It may also provide a useful means of assessing infant communication development in a naturalistic manner, as adults typically scaffold their interactions with infants and encourage learning by providing activities within the Zone of Proximal Development and support to complete these. However, the role of DA in investigating infant communication development remains to be established through research.

Methodology: The present study is using a prospective longitudinal design to explore early communication development in infant siblings of children with Autism Spectrum Disorder and/or language impairment (n=20), as compared to control children (n=40). DA of imitation, receptive language, turn taking and joint attention is being conducted at 9-15 months of age, and the ability of this procedure to predict language and social communication outcomes at age 2 is being investigated.

Results: Results will be presented based on analysis of the Time One assessment data. Preliminary results indicate that using DA adds to the ability of standardised measures to predict concurrent receptive language development. Motor imitation ability in infancy, as assessed by DA, appears to have a particularly strong relationship to language skills, both as reported by parents using the UKCDI (r=0.586 p=0.028) and as assessed using the Pre-School Language Scales-4 (r=0.796, p=0.001).

Conclusions: Dynamic assessment appears to be a useful emerging tool for investigating infant communication development. Replication in further studies will be needed in the future.

Bayes for Babies

Titia Benders and Don van Ravenzwaaij

University of Newcastle, Australia

Experiments on infant language development, as all psychology sub-disciplines, are only publishable with a p-value below the .05 threshold. These p-values and .05 threshold are staples of frequentist statistics and serve double duty in lending credence to empirical results and guarding scientists from overinterpreting data.

Yet, the approach has its limitations and an increasingly popular alternative is Bayesian statistics (e.g., Lee & Wagenmakers, 2014). We argue that Bayesian statistics allow infant language researchers to overcome two main challenges posed to them by frequentist statistics.

Challenge 1: Quantifying what infants cannot do

A plethora of benchmark findings in language development concern infants' inabilities. For example, infants are native listeners once they do not discriminate certain sound contrasts (Werker & Tees, 1984).

Unfortunately, we cannot interpret frequentist p-values over .05 as evidence that infants are unable to perform a task. Bayesian statistics quantify evidence in favor of the null hypothesis and, thus, in favour of infants' inabilities. We re-analyze benchmark null effects with Bayesian statistics to quantify the evidence for the linguistic abilities infants do not have.

Challenge 2: Incremental testing

Infant participants are time-consuming to recruit and test. An efficient use of resources seems to be to analyze data after each participant and stop testing as soon as a publishable statistic is obtained. Unfortunately, such optional stopping artificially inflates the frequentist type-I error (John, Loewenstein & Prelec, 2012). The researcher that uses Bayesian statistics can use optional stopping and interpret her test results with the same level of confidence. We present simulations on data from two large meta-analysis databases on infant language acquisition (Tsuji, Bergmann, & Cristia, 2014) to show under what conditions optional stopping with Bayesian statistics poses an advantage for the infant language researcher.

The effects of maternal education on reports of infants' early vocabulary

Elika Bergelson[1] and Daniel Swingley[2]

[1]*Brain & Cognitive Sciences Department, University of Rochester, USA*
[2]*Psychology Department, University of Pennsylvania, USA*

Parental report is widely used to assess infants' lexicons. The Macarthur-Bates CDI is a predominant such assessment, and includes a checklist from which parents select 'understands' or 'understands and says' for 396 common words (Fenson et al, 1994). Using the CDI, we characterize infant word learning as a function of SES (maternal education; Bornstein et al, 2003), by examining effects of maternal education on infants' reported vocabulary. Generally, lower-SES babies have smaller productive vocabularies, and are slower and less accurate in fixating named images (Bergelson & Swingley, 2013, Fernald et al., 2012, Hoff, 2003; Hart and Risley, 1995).

We aggregated CDI data from a large sample of English-hearing infants (n=570; age: 6-16 mo., M=10 mo.), most of whom were measured more than once longitudinally (M visits=2.6, R=1-8). We linked these data with the mothers' education level (four ordered levels: "high school or less" (n=108), "some college" (n=114), "college degree" (n=136), "advanced degree" (n=212)).

We examined parental report for comprehension and production. We find that SES has opposite effects on these two measures: less educated mothers report higher comprehension vocabularies than more educated mothers, but lower production vocabularies. This pattern holds across parts of speech within the CDI. Both age and mother's education are significant but opposite-valence predictors of comprehension vocabulary (p<.01).

Because it is unlikely that lower-SES infants actually have relatively high comprehension vocabularies but relatively low production vocabularies, we suggest that lower-SES parents overestimate their children's comprehension, for which the their evidence is less direct than for production. These results underscore the potential confounds of asking parents to report on children's early lexicons, and highlight the importance of corpus-based work in measuring infants' language environments, and in-lab measures of early comprehension.

Modeling infant language development

Talk session

Thursday, June 11, 15.30

Chair: Janet B. Pierrehumbert

Modeling concurrent development of speech perception and production in a Bayesian framework

Marie-Lou Barnaud[1], Raphaël Laurent[1], Pierre Bessière[2], Julien Diard [3] and Jean-Luc Schwartz[1]

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It is widely accepted that motor and auditory processes interact in speech perception, but little is known about the functional role motor processes play in the development of speech perception. To address this question we consider a Bayesian model of speech perception development based on three sets of variables: motor representations M, sensory representations S and objects O (e.g. phonological units such as phonemes). The model comprises two internal branches. Firstly, an auditory identification sub-system connects S and O. Secondly, a motor sub-system connecting M and O and a sensori-motor model connecting M and S can be combined to provide "motor identification" of sounds S, from S to M and from M to O, in an analysis-by-synthesis process.

Development is modeled as a learning process in which a master iteratively produces a sensory percept S associated with an object O. The learning agent updates its auditory sub-system by observing S and O. Update of the two other branches is more complex and based on an imitation phase. The learning agent estimates a likely motor action M from input S, produces this M and observes the resulting sound S'. M, S' and O are used to update both the motor sub-system (M, O) and the sensori-motor model (S, M).

We show that the auditory identification sub-system learns rapidly, and becomes efficient for stimuli close to those provided by the master, although it generalizes poorly. By contrast, the two other sub-systems evolve more slowly, and in consequence the motor identification system performs less accurately. However, motor identification happens to have captured more variable situations during learning, and generalizes better (e.g. in noise). This is in line with a developmental schedule in which auditory processing is mature before motor knowledge (Kuhl et al, 2008) and is exploited by infants after 11 months of age for analysis-by-synthesis of unusual speech stimuli (Kuhl et al., 2014).

Learning French vowels is easier when they are prominent

Ingeborg Roete[1], Maarten Versteegh[2], Alejandrina Cristia[2], Emmanuel Dupoux[2] and Paula Fikkert[3]

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In English, the automatic clustering of vowels /i/,/I/,/E/ and /E/,/æ/,/A/ spoken by one speaker into categories is improved by using tokens with prosodic emphasis (Adriaans & Swingley, 2012). If infants pay more attention to focused elements in speech (cf. Speer & Ito, 2009), then this hyperarticulation may have a functional role in English. But is prominence-specific hyperarticulation also found in typologically diverse languages? Using a computer model, this study investigates whether these findings can be extended to a language that does not use stress contrastively, French, and a wider range of vowels and speakers.

The French point vowels /A/, /i/, /u/ were automatically extracted from 14 speakers in a large corpus of conversational French speech (CID corpus, Bertrand, 2008). A z-score greater than 0.5 on pitch, pitch range or vowel duration was taken as a feature indicating prosodic emphasis. Components in Gaussian mixture models were used to represent the vowel categories based on their F1 and F2 values at midpoint. We trained and compared three models using one Gaussian per vowel category. The first model was trained on just the prominent vowels and the second on all vowels, both being trained with an unsupervised algorithm. The third model was trained in a supervised fashion on all the vowels.

The French results show the same pattern as the English ones: the model trained only on the prominent vowels has higher adjusted Rand index scores (x= 0.5398), reflecting a higher clustering accuracy than the model trained on all vowels (x= 0.4923). The supervised model has a score of x= 0.5703. The accuracy scores were averaged over 50 runs. These findings suggest that infants learning the sounds of their language will have an easier task if they pay attention only to the focused vowels even in languages without lexical stress.

An ecological model of early language acquisition

Francisco Lacerda

Stockholm University, Sweden

This presentation proposes an interactive and situated model for the emergence of lexical items early in life. The model builds on the interplay between the young infant's general multi-sensory and motor abilities, the affordances provided by the infant's ecological environment and the characteristics of spontaneous speech directed to infants and young toddlers at different developmental stages. It is suggested that linguistic functions early in life can be seen as emerging from the interplay between memory processes and the interaction patterns between the infant and speakers of the ambient language, within the infant's ecological context.

A mathematical implementation of the model will be presented and used to study of the potential impact of different initial assumptions on memory span and its interaction with a selection of properties of infant-directed speech.

Infant speech perception

Talk session
Friday, June 12, 08.30
Chair: Tineke M. Snijders

On the basis and attentional effects of native language preference in infants

Hanna Marno[1], Bahia Guellai[2], Yamil Vidal Dos Santos[1], Marina Nespor[1] and Jacques Mehler[1]

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Native language perception has wide range of strong effects on infant's social cognition from a very early age including newborns' preference for listening to their native language (Nazzi et al., 1998; Mehler et al., 1988), 6-month-olds' preference for native speakers (Kinzler et al., 2007) 12 month-olds' higher sensitivity to native speaker's attitude (Shutts et al., 2009), and choosing friends based on their spoken language around the age of 5 (Kinzler et al., 2009). In two studies, we investigated whether this preference for native language in infants is based on differences in rhythmical classes and whether its effect also extends to attentional processes.

In the first experiment, 4-5 month-old monolingual Italian infants (N=40) watched female speakers who were either talking in Italian, or Slovenian (different rhythmic class), or Spanish (same rhythmic class). Infants preferred to look at the Italian speaker over the Slovenian speaker, but we found no difference in looking time between the Italian and the Spanish speakers. Thus, 4-5 month-old infants show a preference not specifically for speakers with whom they share the same language, but also with whom their language shares the same rhythmical class.

In the second experiment, 12-month-old monolingual Italian infants (N=40) were first familiarized with an Italian and a Slovenian speaker. After the familiarization, infants saw a sequence of movies, where each of the two speakers silently gazed towards two different objects. At the test phase, infants saw the two objects either together, or each paired with a novel object. When seeing pairs with a new object, the infant showed classical novelty preference. However, when the two familiar objects appeared together, infants looked significantly longer at the object that was presented by the Italian speaker. We propose that this selectivity is a useful tool when infants have to choose between potential sources of information in their social environment.

Discrimination of lexical tones by native and non-native infants

Xian Hui Seet, Ashley P. Y. Tong, Charlene S. L. Fu and Leher Singh

National University of Singapore, Singapore

Thus far, the majority of studies on infant speech perception have focused on Romance and Germanic languages and by extension, on consonant-vowel phonologies. Tone languages, which predominate across human languages, are vastly under-researched. Recent research has begun to reveal that crucial linguistic milestones attained by infants differ for tone languages (e.g. Yeung, Chen & Werker, 2013). Across two experiments, we studied the process of phonological attunement to lexical tone in Mandarin, using paradigms previously used for consonant-vowel systems. Using the stimulus alternating procedure, we tested 80 infants exposed to Mandarin only or English only at 2 age groups: 6 months and 9 months. We compared discrimination of an easy contrast (Tones 1 vs. 3) with a difficult contrast (Tones 2 vs. 3) for all infants. Results demonstrated that Mandarin infants were able to discriminate the easy contrast at 6 months and both the easy and difficult contrasts by 9 months. In comparison, English infants were not able to discriminate either contrast at 6 months, but were able to discriminate the difficult contrast by 9 months. In light of the emergence of tone sensitivity in English infants, we conducted follow-up testing with English infants at 13 months. At this point, English infants were able to discriminate both tone contrasts. Results suggest that Mandarin infants demonstrate early sensitivity to tone contrasts and in particular, to dissimilar tone pairs. As expected, they become increasingly sensitive to tone with age. In comparison, English infants did not demonstrate a sensitivity to tone at 6 months, but paradoxically, became increasingly sensitive to tone over the first years of life showing robust tone discrimination abilities by 13 months. Findings point to a distinct course of phonological attunement for lexical tone as previously documented for vowels and consonants.

Only high-pitched stressed syllables are good word onsets for German infants

Katharina Zahner, Muna Pohl and Bettina Braun

Universität Konstanz, Germany

German infants use stressed syllables for segmentation [1], but their stress perception depends on utterance-level intonation [2]: In a head turn preference paradigm, 10-month-olds segmented embedded trochees from trisyllabic carriers in an f0peak-stress-association condition (sign. novelty effect of 1164ms, 95%CI [75ms;2154ms]), but failed in an f0peak-stress-dissociation condition with the f0-peak preceding stress (n.s. familiarity effect of 109ms). The failure to segment may be due to the low input frequency of this contour (12% of 99 analyzed CDS accents from CHILDES). Here, we investigate whether these results replicate with a more frequent dissociation condition (f0-peak following stress: 51% in corpus).

18 infants (av. 38.9 weeks, SD=1.3) were familiarized with the same utterances as in [2]. The passages were recorded anew, but the trisyllabic carriers (e.g., [la.ˈguː.nə]) were produced with a low stressed syllable followed by a rise (matched for pitch range, duration and vowel quality with previous carriers). Procedure and test stimuli were identical to [2]: After familiarization, infants listened to 3 repetitions of 4 test lists (2 familiar/2 novel), each containing 15 tokens of trochees that were embedded in the trisyllabic carriers during familiarization (e.g., [ˈguː.nə] from [la.ˈguː.nə]).

The results showed a n.s. familiarity effect of 184ms (95%CI [-981ms;764ms]). The patterns of the two dissociation conditions are identical, despite their different frequency of occurrence. This corroborates the claim that German 10-month-olds only take stressed syllables as word onsets when these are high-pitched. The underlying mechanism appears to be the salience of high-pitched stressed syllables rather than the frequency of the intonation pattern in the infants' input.

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Early language comprehension and lexical development 2

Talk session

Friday, June 12, 10.00

Chair: Anne Christophe

The early development of lexicon and MLU: An exploratory longitudinal study

Jocelyn Marzan

University of the Philippines - Manila, Philippines

This was an exploratory longitudinal study detailing the spoken language patterns of 6 typically developing Filipino toddlers and/or pre-school children from middle income Tagalog English families.

Seventy-eight half hour videos (10-16 videos per child) were recorded every 2 months during normal family interactions when the children were between 14 – 60 months old. The recordings were transcribed using the Codes for the Human Analysis of Transcripts (CHAT) and data was extracted using the Computerized Language Analysis (CLAN) program (MacWhinney, 2000). Morphosyntactic analysis using CLAN was adapted to Tagalog using Schachter & Otanes (1972) and Nolaso (2010).

The language development of these Filipino children was consistent with universal patterns. This includes mean length of utterance (MLU) and vocabulary growth rates, a marked increase at 20-24 months in rate of lexical development, an increase of 1.4 morphemes per utterance for every 1000 new lexical items in their vocabulary, a predominance of content over function words, and a lexicon of 1200 words at 42 months of age. Within each half hour recording session, each child used 87 lexical items not used in previous months.

Characteristics specific to these children were a use of both Tagalog and English, with a predominance of English for nouns but a balance of the two languages for verb stems; and higher frequency use of pronouns over verbs and nouns whereas other studies show a preponderance of nominal (Capone, Haynes, & Grohne-Riley, 2010). Code-mixing included the use of English verb stems inflected in Tagalog.

The data contained in this study can form an initial index for normative language acquisition. Refinement and expansion of the database is recommended to enhance its utilization.

Isolated words in input to infants: A critical wedge?

Tamar Keren-Portnoy and Marilyn Vihman

University of York, UK

The importance for early lexical development of hearing words in isolation as compared with having to segment them from running speech is hotly debated (e.g., Aslin et al., 1996, Brent & Siskind, 2001, Fernald & Hurtado, 2006; Lew-Williams et al., 2011; Junge et al., 2012). Brent and Siskind (2001) demonstrated that isolated-word frequency in input speech better predicts later word use than overall frequency. Thus, although it is established that by 12 months infants are able to segment the speech stream with the help of distributional cues, this need not be the primary way that infants learn words.

We tested the effects on 12-month-olds of hearing words in isolation as compared with sentence-finally. Parents read their infants a picture book with unfamiliar words, presented either in isolation or sentence-finally, daily for 3 weeks. Infants were tested in the Head-turn Preference Procedure, contrasting words trained in isolation, trained sentence-finally and untrained. The 3-way comparison (Exp. 1) produced only marginally significant results. In Experiments 2 and 3 infants were tested on only one training type (isolated word or sentence-final), contrasted with untrained words. Experiment 2, with stimuli in word lists) showed recognition for words trained in isolation (t = 3.49, df = 15, p < .01) but not for words trained sentence-finally (t = .04, df = 15, p = .97). Results from Experiment 3 (with words embedded in passages) will be available in time for the conference.

Although the reported proportion of isolated-word use in IDS ranges from 9% (Aslin et al., 1995; Brent & Siskind, 2001) to 39% (van de Weijer, 1998), there is reason to believe that these words play a disproportionate role in word learning, in that they may initiate the process of segmentation. Our study provides further evidence that isolated words may afford a 'critical wedge' into the speech stream.

Infants' recognition of familiar words in foreign accents

Marieke van Heugten[1], Dena Krieger[2], Melissa Paquette-Smith[2] and Elizabeth K. Johnson[2]

[1]*Ecole Normale Supérieure / EHESS / CNRS / PSL Research University, France;* [2]*University of Toronto, Canada*

Although adults typically adapt to unfamiliar accents very quickly, infants are initially unable to recognize familiar words spoken in unfamiliar accents (see Cristia et al., 2012 for a review). By around two years of age, however, English-learning children overcome this limitation (Best et al., 2009; Mulak et al., 2014; Van Heugten & Johnson, 2014). But most work examining infants' ability to recognize words in unfamiliar accents has focused on children's perception of regional accents of English. Much less is known about infants' recognition of familiar words in foreign accents. There is good reason to suspect the development of children's ability to cope with regional versus foreign accents might differ given evidence that foreign accents are less consistent than regional accents (e.g., Floccia et al., 2009). Here, we examine this issue by testing English learners' recognition of English words in an unfamiliar French accent.

Using the Headturn Preference Procedure, 15-, 18-, and 22-month-olds were presented with lists containing either known (e.g. bottle) or unknown French-accented words (e.g. bocky). Like previous studies examining children's recognition of words in regional accents (Best et al., 2009; Van Heugten & Johnson, 2014), we found that 15-month-olds listened equally long to both list types. By contrast, the two older age groups displayed a clear preference for known over unknown words. Thus, at least for the French accent tested in the current study, the time course of the development of the ability to recognize foreign-accented words resembles that of regional accents, reinforcing the notion that children's ability to contend with accent variation becomes robust before their second birthday. In an attempt to understand the mechanisms underlying the behavior observed in this study, we are now testing infants' tolerance of vowel mispronunciations (e.g. bittle) in French-accented English.

Infant-directed speech 1

Talk session
Friday, June 12, 14.00
Chair: Mats Wirén

Is the early acquisition of onomatopoeia internally or externally motivated?

Catherine Laing

University of York, UK

It has been acknowledged that less-than-arbitrary sound-meaning links may be advantageous for infants in the early stages of language development (Imai & Kita, 2014), and this has been confirmed by studies of Japanese mimetics (e.g. Imai et al, 2008). However, onomatopoeia have received much less consideration in the literature, despite appearing widely in the early words of infants across a range of languages (Menn & Vihman, 2011). In fact, these forms are often overlooked, despite a wealth of research demonstrating a role for other forms of iconicity in development.

This study considers the role of onomatopoeia in early word perception. The question of an iconic advantage for onomatopoeia was considered using eye-tracking to compare infants' responses to onomatopoeic words (OWs, e.g. quack) with their conventional counterparts (CWs, e.g. duck). Prelinguistic infants were found to match OWs to a target image significantly more often than CWs (p=.039), and an advantage was found for iconicity in the speed of infants' responses (p=.04). These results suggest a role for onomatopoeia in early language learning, in line with the literature positing a bootstrapping effect for iconic forms (Imai & Kita, 2014).

The question of the input was then considered in order to understand how infants experience OWs in caregiver speech. Recordings of 12 British mothers reading picture books to their 8-month-olds were analysed in Praat in order to compare the prosodic features of OW-CW pairs. Mean pitch, pitch range, word duration, pause duration and repetition were analysed – features typically reported in infant-directed speech (IDS, Fernald & Kuhl, 1987). OWs were found to be significantly more salient than their CW equivalents across all the typical features of IDS, suggesting that the advantage for OWs in early language perception may well be acoustic, rather than iconic, owing to the more salient prosodic features that characterise the presentation of OWs in the early input.

What is child-directed speech good for? A quantitative multi-level analysis

Alejandrina Cristia[1], Adriana Guevara-Rukoz[2], Bogdan Ludusan[3], Andrew Martin[4], Reiko Mazuka[4], Thomas Schatz[3], Roland Thiolliere[3], Maarten Versteegh[3] and Emmanuel Dupoux[3]

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In (nearly) all cultures, parents speak to their child in a special way (Ferguson, 1964). The *functional* role of this special child-directed speech (CDS) register, however, remains controversial. We systematically measured the discriminability of linguistic categories using speech technology and machine learning tools on a large corpus. The database contains speech by 22 Japanese mothers addressing their 18- to 24-month-old child and adults (total over 14 hours), which has been carefully annotated at the sound, word, and prosodic level.

The analysis of over 40 sound contrasts in syllabic minimal pairs (including both vowels and consonants) revealed that phonemic contrasts were overall less discriminable in CDS than in adult-directed speech (ADS). However, prosodic boundaries were significantly more discriminable in the CDS (compared to the ADS) of those same mothers.

Since prosodic boundaries are useful for word segmentation (e.g., Seidl & Johnson, 2006), we hypothesized that mothers' CDS may have other features that promote lexical acquisition. In view of the phonemic results above, we carried out two distinct analyses. In one, we inspected the transcribed form of words using edit distance; in the other, we looked at their acoustic realizations. The former analysis showed that word forms are more distinct in CDS than ADS, a difference that could not be explained by other variables (e.g., token/type ratios). The expansion in words' transcribed form was just enough to counter a reduction observed in their acoustic realizations. Thus, words end up being equally easy to discriminate in CDS and ADS.

In this large-scale quantitative approach, we were able to study in depth properties relevant to the learning of sounds, words, and prosodic boundaries. We can thus demonstrate that, if there is a functional role to CDS, it more likely involves promoting larger units (e.g., words and phrases), rather than individual sounds.

Infant directed speech to infants at- and not-at-risk for dyslexia

Marina Kalashnikova and Denis Burnham

The MARCS Institute, University of Western Sydney, Australia

Infant Directed Speech (IDS), compared to Adult Directed Speech (ADS), shows higher and more varied pitch, higher affect, and hyperarticulated vowels. Vowel hyperarticulation in IDS has been shown to be positively related to infants' early linguistic abilities, such as speech sound discrimination and word recognition, but despite many reports across infant age and languages, vowel hyperarticulation is not ubiquitous in IDS since it is reduced or absent when infants' hearing is impaired. Might this reduction also be apparent in speech to infants with a more cognitive than sensory impairment? Dyslexia is a neurodevelopmental disorder manifested in childhood reading and spelling difficulties, and also in auditory processing and speech perception by infants at familial risk for dyslexia (with at least one dyslexic parent). IDS to at-risk infants has not yet been investigated.

Twenty-six mother-infant dyads participated: 13 in the at-risk (AR) for dyslexia group (one parent diagnosed with dyslexia), and 13 in the not-at-risk (NAR) group (no family history of language disorders). Mothers' speech was recorded when addressing their infants at the ages of 9 and 11 months (IDS) and another adult (ADS). IDS/ADS indices were computed for pitch height, affect, and vowel triangle area, where an index of 1 indicates no difference between registers. There were no group differences for pitch or affect (Fs<1), but vowel hyperarticulation indices for mothers in the NAR group were significantly greater than those in the AR group, $F(1, 24) = 5.813$, $p = .024$. Hyperarticulation indices were significantly higher than 1 in the NAR ($p < .01$), but not the AR group ($p > .1$).

Thus, familial risk for dyslexia appears to affect hyperarticulation of vowels in parental speech, which may impact the child's later linguistic development. This suggests that infants with familial background for dyslexia experience a different linguistic environment from as early as the first year of life.

Infant-directed speech 2

Talk session
Friday, June 12, 16.30
Chair: Christa Lam-Cassettari

Word frequency and semantic cues for noun categorization in child-directed speech

Sara Feijoo[1], Elisabet Serrat[2] and Carme Muñoz[1]

[1]Universitat de Barcelona, Spain; [2]Universitat de Girona, Spain

How do children learn the basic grammatical categories of their language? Several studies (e.g. Smith, Smith & Blythe, 2011) point out that semantic information guides initial word categorization (e.g. nouns predominantly denote objects while verbs denote actions). On the other hand, other studies (e.g. Monaghan, Christiansen & Chater, 2007) suggest that children initially attend to the distributional context of words, as they have no access to semantic information in their first months of life. The present study aims at investigating the role of word frequency and the way in which syntactic and semantic cues could interact to provide reliable information for word categorization. We examined the characteristics of nouns in the input addressed to four English-learning infants from the Manchester corpus (Theakston et al. 2001) in the CHILDES database. In particular, we considered all utterances addressed to children who were 2.5 years old or younger. The statistical strength of category membership using semantic and syntactic variables was weighed by means of discriminant analyses. The results from this study show that, while it is true that semantic cues are quite reliable for low- and mid-frequency words, high-frequency words are poorly categorized on the basis of semantic information alone. On the other hand, distributional cues seem to be more reliable for the categorization of high-frequency words.

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The impact of test register on infants' word learning abilities

Melanie Steffi Schreiner and Nivedita Mani

University of Göttingen, Germany

Pre-exposure to phonological word forms helps infants to learn object associations for these words (Swingley, 2009). But, this may be restricted to infant-directed speech (IDS) – infants find it notoriously hard to segment and learn words from adult-directed speech (ADS) (Singh et al., 2009; Graf Estes & Hurley, 2013). We, therefore, compared the effect of pre-exposure to words in IDS and ADS on infants' ability to learn object associations for these words. We also examined if infants exposed to a word in a particular register, e.g., IDS, during training are able to recognize the same word in a different register, i.e., ADS, at test. In a pre-exposure phase, German 18-month-olds (n=46) listened to fluent passages containing a critical word in IDS or ADS. During an on-screen training phase, infants were separately presented with two objects and heard labels for them in the same register as the pre-exposure phase. One of the labels was already familiar from the pre-exposure phase while the other was novel. During the test phase, infants saw both objects onscreen and heard the label of one object in IDS or ADS. Had infants learned the word-object associations, they should look more towards the labeled object upon hearing its' name. We found a significant effect of naming (p=0.006) when the test stimuli were presented in IDS: regardless of pre-exposure or on-screen training in IDS or ADS, infants were able to show successful word learning only when the auditory stimuli at test was in IDS. Contrary to previous findings, our infants showed successful word learning regardless of pre-exposure and training register as long as they were assessed in IDS. Thus, the speech register at test strongly influences infants' ability to correctly identify previously learned word-object associations. This result supports IDS as a source of promoting attention in solving a preferential looking task and adds to the discussion of the beneficial impact of IDS on early language acquisition.

Vocabulary development when input is fragmented: Comparing child-directed speech and word learning in Brazil and the U.S.

Catharine Echols[1], Poliana Barbosa[2], André Souza[3] and Cláudia Cardoso-Martins[4]

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Although specific relationships between child directed speech (CDS) and vocabulary development are well documented, fewer studies explore how these relationships differ cross-linguistically. Brazilian Portuguese (BP) is particularly interesting: not only does it permit subject dropping, but omission of objects and other grammatical elements is pervasive. We explore implications of this fragmented input in a series of analyses from a longitudinal study with 35 BP-speaking mother-child dyads in Brazil and 18 English-speaking dyads in the U.S. Dyads were video-recorded in their homes during semi-naturalistic play sessions when children were 9, 13, and 18 m old; vocabulary was assessed using the MCDI.

Our findings confirmed that BP CDS is highly fragmented: 61% of BP child-directed utterances contained omissions (with only 13% being grammatical subject droppings) versus 16% in the U.S. sample. Despite its fragmented nature, relationships between CDS and vocabulary in BP were similar to those observed in English: Children's nouns correlated significantly and positively with maternal use of copulas and questions, and negatively with imperatives (cf., Newport et al., 1977). Interestingly, the frequency of sentence fragments was not associated with children's vocabulary growth.

We also explored whether the fragmented speech provided sufficient information to predict grammatical categories. In an analysis similar to Mintz (2003), frequent frames were extracted from both the English and BP samples. Hierarchical cluster analyses were used to evaluate similarity of grammatical categories within frames. Despite the fragmented nature of BP CDS, frequent frames were highly reliable in distinguishing grammatical categories, consistent with patterns observed in English.

These findings suggest that, despite the highly fragmented nature of BP CDS, it supports vocabulary development in much the same way as less fragmented English CDS. Potential explanations will be discussed.

ABSTRACTS

Poster sessions

Poster session 1
Wednesday, June 10, 15.30
Bilingual language development in infancy
Infant speech perception
Social factors of language acquisition

Poster session 2
Thursday, June 11, 13.00
Neurodevelopmental aspects of language acquisition
Atypical language development
Language acquisition and cognition
Null-results in well-designed and theoretically sound experiments

Poster session 3
Friday, June 12, 15.30
Early speech production
Early language comprehension and lexical development
Infant-directed speech

Bilingual language development in infancy

Poster session 1

Wednesday, June 10, 15.30

Cross-linguistic transfer of word segmentation abilities in bilingual infants

Victoria Mateu Martin and Megha Sundara

UCLA, USA

In this study we ask whether bilingual English- and Spanish-learning infants can segment Spanish words. Both Spanish and English have lexical stress. In contrast to English, where 90% of content words begin with a stressed syllable, Spanish has variable stress such that stressed syllables are not aligned with word boundaries. Previous research has shown that monolingual English- and Spanish-learning 8-mo-olds fail to segment Spanish trochees when familiarized with Spanish passages for 45s (Sundara & Mateu, 2013; Bosch, p.c.). However, with extended exposure (60s), English-learning 8-mo-olds succeed at segmenting Spanish trochees, not iambs. Thus, monolingual English-learning infants' can successfully segment Spanish trochees by treating stressed syllables as word onsets

If bilingual infants can transfer the ability to treat stressed syllables as word onsets from English, we expected their ability to segment Spanish trochees to be facilitated. Bilingual Spanish- and English-learning 8-mo-olds (n=32) were familiarized with Spanish passages for 45s and tested on their ability to segment Spanish trochees using the classic Headturn Preference Procedure. Infants' exposure to Spanish ranged from 7%-93%. In an ANCOVA with percentage of Spanish exposure as a covariate, the main effect of trial-type was significant (p=.02). That is, infants with little exposure to Spanish showed a familiarity preference, whereas infants with greater exposure to Spanish showed a novelty preference. This is surprising since neither monolingual 8-mo-old group was able to segment Spanish trochees with a 45s familiarization. To ensure that bilinguals were not merely segmenting the strong syllable, we again familiarized them with Spanish passages for 45s (n=36; Spanish exposure 14%-83%) but tested them on the stressed syllable. An analogous ANCOVA showed no significant effect of trial-type (p>0.1). Thus, bilinguals, not monolingual Spanish-learning 8-mo-olds successfully segment Spanish trochees.

Can non-speech movements drive monolingual and bilingual infants' attention from the mouth of a talking face?

Mathilde Fort, Anira Escrichs, Alba Aneyto Gimeno and Nuria Sebastian-Galles

Universitat Pompeu Fabra, Center for Brain and Cognition, Spain

When watching at a talking face, infants from 6 to 10 months of age pay more attention to the mouth rather than to the eyes of the speaker. At 12 months, infants' preference for the mouth over the eyes region is still present but smaller, while their visual attention towards the eyes region increases (Lewkowicz & Hansen-Tift, 2012). During the same period, bilingual infants show a more stable behavior: they focus on the mouth region earlier in their development (at 4-month-old) and this preference remains unchanged later on (at least until 12 month-old, Pons et al., 2013).

The goal of this study was to investigate how different attentional pattern to talking faces impact monolingual and bilingual 15-months-olds' ability to process the apparition of visual information in the speaker's eyes/mouth region. We recorded Spanish/Catalan bilingual and Spanish and Catalan monolingual infants' eye gazes while they watched and listened to a bilingual Spanish/Catalan female speaker producing short sentences. At the end of each sentence she either protruded her lips (N=30, 16 bilinguals) or raised her eyebrows (N=31, 16 bilinguals).

Data collection is still underway but our results are in line with Lewkowicz & Hansen-Tift (2012) and Pons et al. (2013): monolinguals do exhibit different attentional pattern to talking faces than bilingual infants. Monolinguals looked longer at the mouth region in the Lip-Protrusion condition and at the eyes region in the Eyebrows condition, both during the sentences and the non-speech movements (both $p < .05$). Bilinguals however looked preferentially at the mouth region in both conditions during presentation of the sentences, and only increased their looking time to the eyes region in the Eyebrows condition during the non-speech movements (sentence $p = .21$, non-speech movement, $p < .05$). We are now collecting more data in order to better qualify the mechanisms (e.g., anticipation) underlying this change of attentional pattern.

The acquisition of translation equivalents in young bilinguals: A longitudinal study

Diane Poulin-Dubois[1], Cristina Crivello[1], Pascal Zesiger[2] and Margaret Friend[3]

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Most bilingual children have at least some translation equivalents (TE) in their early receptive and expressive vocabularies (Bosch & Ramon-Casas 2014; Byers-Heinlein & Werker, 2013). Although several studies have now examined the process of TE acquisition in young bilinguals, the majority of these studies have been cross-sectional and have only reported the total TE scores. The goal of the present study was to examine the continuity of TE acquisition in three word classes using a longitudinal design. The vocabulary of a sample of 30 French-English bilingual children was assessed at the age 17, 24, and 31 months. Parents completed the Quebec French and American English adaptations of the CDI:WS at each wave. The proportion of translation equivalents per word class was calculated by totaling the number of TEs on the CDIs for nouns, verbs and adjectives separately and dividing this value by the total number of TEs. The results revealed that the proportion of nouns that were TEs increased steadily from 17% at 17 months to 66% at 31 months. In contrast, the proportion of words in the verb category on the CDI that were TE was very low at each wave but increased significantly between Wave 1 (1.6%) and Wave 3 (9.27%). Similarly, TE that were adjectives raised from 1.6% (Wave 1) to 6.2% (Wave 3). These findings suggest that most translation equivalents in expressive vocabulary are nouns in young bilingual's vocabulary, in accord with the noun bias hypothesis. The acquisition of translation equivalents will also be discussed in terms of the effect of form similarity.

Bilingual infants' discrimination of Mandarin tone contrasts

Charlene S. L. Fu, Joelle L. Wang, Felicia L. S. Poh and Leher Singh

National University of Singapore, Singapore

Phonological attunement in bilingual infants has been the focus of an increasing number of studies, several of which have identified unique developmental trajectories for phoneme discrimination as compared to monolingual infants (e.g. Bosch & Sebastián-Gallés, 2003). The majority of these studies have focused on the consonant-vowel phonologies of Romance and Germanic languages in comparison to more widely spoken tone languages. Recent research (e.g. Liu and Kager, 2014) has revealed differences in the development of phonetic categories for tone in infancy as compared to consonants and vowels. This study investigates the timeline of phonological attunement for Mandarin tones in bilinguals exposed to one tonal (Mandarin) and one non-tonal (English) language with the use of the stimulus alternating paradigm. Thirty-two bilingual infants were tested on their ability to discriminate two tone contrasts – one Easy (Tones 3 vs. 1) and one Difficult (Tones 3 vs. 2) contrast. Infants were tested at 6 months and 9 months. Results revealed that 6 month old bilingual infants were unable to discriminate either contrast. At 9 months, infants could discriminate the easy but not difficult contrast, suggesting modest improvement. In comparison to other studies with monolingual infants revealing tone discrimination as early as 4 months (e.g Yeung, Chen & Werker, 2013), bilingual infants appear to show an unexpectedly protracted course of phonological attunement for tone. To understand the extent of this delay, data were collected from an additional group of 13 month olds. It was found that bilingual 13 month olds were unable to discriminate both contrasts. This points to a longer delay than has previously been documented for consonants and vowels (e.g. Bosch & Sebastián-Gallés, 2003), and suggests a unique, and more complex, developmental timeline for lexical tone discrimination in bilingual infants.

Factors influencing language acquisition of bilinguals age 3-5 in child care

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Bilingual children have often been shown to have lower majority language skills than monolingual children do, but to narrow the gap through the school years (Golberg, Paradis, & Crago, 2008; Oller, Pearson, & Cobo-Lewis, 2007). In a cross-sectional design, the present study examined majority language acquisition in 1,000 bilingual children aged 3-5 in Danish child care. The bilinguals were assessed on a comprehensive language assessment tool, and their scores were compared to those of same-aged monolingual Danish children. The results showed that the bilingual children at age 3 had much lower Danish language skills than monolingual Danish children. At age 5, the gap in Danish skills between bilingual and monolingual children was narrower than at age 3, presumably because the bilinguals increase their total Danish language input through the ages 3 to 5. However, the extent to which the gap between bilinguals and monolinguals narrowed varied with type of language measure. In addition, family background characteristics influenced the extent to which the gap narrowed, indicating that differential language support strategies are needed for different bilingual children.

Associative word learning in monolingual and bilingual infants: Evidence for a bilingual advantage

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To learn the meanings of words, infants must correctly bind native word forms to the conceptual world. This process is thought to be particularly challenging with similar sounding words (e.g. Stager & Werker, 1997). These difficulties appear to be compounded in bilinguals, who have reported delays in their ability to link similar sounding words to different meanings (Fennell, Byers-Heinlein & Werker, 2007). In a pair of studies designed to investigate whether a delay in minimal pair learning extends to other sources of variation, 36 monolingual and bilingual infants were compared at 18 months on two experiments via the switch paradigm. In Experiment 1, mispronunciations took the form of a vowel change from /I/ to /u/ in contrast to previous studies. Responses to correct pronunciations and mispronunciations were tracked. Bilingual participants demonstrated mispronunciation effects for a vowel change but monolingual infants were not sensitive to vowel mispronunciations at 18 months. In a second experiment, bilingual and monolingual infants were compared on their responses to words that varied in indexical detail, specifically, talker gender. Both monolingual and bilingual correctly treated variation in talker gender as irrelevant to the lexical identity of a word in equal measure. Results demonstrate that both monolingual and bilingual infants recognize non-phonemic sources of variation as lexically irrelevant. However, only bilingual infants were sensitive to vowel mispronunciations and unlike monolingual peers, they correctly recognized phonemic vowel variation to be lexically relevant.

The development of phonemic discrimination in Basque-Spanish bilingual infants

Saioa Larraza[1], Monika Molnar[2] and Arthur Samuel[2]

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Spanish-Basque bilingual adults' phonemic discrimination capacity is determined by their linguistic experience; early and late bilinguals' performance is poorer and/or slower than the one by Spanish-Basque simultaneous bilinguals who learned both languages from birth [Larraza, 2014]. We tested whether these group differences are already visible at very early stages of development in infants with distinct exposure to the two languages.

Two contrasts that operate in Basque but not in Spanish were studied: a contrast between fricatives (/s̺/-/s̻/) and affricates (/t̠ʃ/-/ts̻/). Using the visual habituation procedure, we assessed when language-specific effects in discrimination appear. Previous research demonstrated that sensitivity to native phonemic categories increases during first year of life: by 6 months of age the development of native vowel categories is observed; and by 11 months, native consonant category formation takes place. To analyze age and exposure related changes in monolingual and bilingual infants' phonemic discrimination, we tested infants at different ages (6-7 and 11-12 months) including Basque-dominant, Spanish-dominant and Basque-Spanish bilingual infants.

Results will be discussed in the context of prior studies done with monolingual infants, as well as with recent findings in cross-language speech perception. Additionally, the outcome will shed some light on the conflicting results found in the literature on simultaneous bilinguals' development. It is not clear yet whether simultaneous bilingual infants build native categories similarly to their monolingual peers in case of within- and across language contrasts [e.g., Bosch et al. 2003; Sundara et al. 2008; Albareda et al. 2011]. Our last question focuses on the role that phonetic salience might play on the ease of discrimination of each type of contrast (i.e., fricative vs. affricate).

Language preferences of monolingual infants from bilingual and monolingual communities

Monika Molnar and Manuel Carreiras

BCBL, Spain

Most infants growing up in bilingual communities are exposed to two languages from birth via interaction with their caregivers. In bilingual communities, it is also common for caregivers to report that their infant regularly hears one language only (e.g., at least 90% of the time). Developmental research typically considers these infants monolingual, similarly to those growing up in monolingual communities. However, monolingual infants from bilingual communities often receive minimal exposure to the other language of their environment (e.g., by overhearing). Because as little as 5 hours of foreign language input may be sufficient to shape infants' linguistic abilities (Kuhl, Tsao, & Liu, 2003), it is a possibility that monolingual infants from bilingual vs. monolingual regions develop different perceptual sensitivities to their ambient language(s).

Using a behavioral paradigm, we assessed whether monolingual infants growing up in a monolingual or a bilingual environment exhibit the same perceptual preferences to their native and non-native languages. We recruited 4-month-old monolingual Basque infants (at least 90% Basque exposure) from a Spanish-Basque bilingual region (n=14), and from a Basque monolingual region (n=14), in addition to Basque-Spanish bilingual infants (n=14; at least 30% exposure to one of the languages). Monolingual infants from monolingual communities exhibited a clear preference to their native language, however the monolingual infants from the bilingual region demonstrated the same behavior as their bilingual peers (equal preference across inputs). Therefore, as early as 4 months of age, monolingual development is affected by minimal exposure to another language, and monolingual infants from bilingual vs. monolingual communities adjust their early perceptual sensitivities according to their greater environment.

Infant speech perception

Poster session 1

Wednesday, June 10, 15.30

When infants get the question: The development of boundary tone perception

Megha Sundara[1], Monika Molnar[2] and Sónia Frota[3]

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Pitch can signal differences in word meaning like consonants and vowels (e.g. Mandarin), or mark prominence and/or edges of prosodic units (e.g., English, Portuguese). Like consonants and vowels, infants' ability to discriminate lexical pitch becomes language-specific with age (e.g., Mattock & Burnham, 2006). We know less about when infants perceive pitch marking of prosodic units. In Portuguese, statements and yes/no questions are segmentally identical but distinguished by a fall versus a rise on the final syllable; and Portuguese 5- and 8-month-olds are able to distinguish them in the presence of segmental variability (Frota, Butler & Vigário 2014). Using visual habituation in a design like that used by Frota et al., (2014), we investigated English-learning 4-mo-olds' ability to distinguish Portuguese boundary tones. In Expt. 1, infants failed to categorize segmentally varied Portuguese bisyllabic statements vs. questions (t(21) = 1.9, p=0.08). In Expt. 2, we simplified the task by removing segmental variation (only /lamu/ sequences with either a final fall or rise were tested). Again, infants failed (t(21) = 1.9, p=0.1). Finally, in Expt. 3, we tested /lamu/ but with a more sensitive procedure (50% habituation criterion vs. 60% used in Expts 1 & 2). Now, English-learning 4-mo-olds successfully discriminated Portuguese statements vs. questions (t(20) = 4.0, p=0.001). Thus, unlike their Portuguese-learning peers, English-learning 4-mo-olds are limited in their ability to distinguish Portuguese statements vs. yes/no questions; they do so only in the absence of segmental variability, when tested in a sensitive procedure. This implies that Portuguese-learning infants' perception of boundary tones is already language-specific at 5-months. Additionally, our results provide a way to reconcile previous puzzling findings about English-learning infants' difficulty categorizing English statements from yes/no questions (e.g., Soderstrom et al., 2011).

Semantics guide infants' vowel learning: Computational and experimental evidence

Sophie Ter Schure[1], Paul Boersma[1] and Caroline Junge[2]

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In their first year, infants' perceptual abilities zoom in on only those sound contrasts that are relevant for their language. Infants' lexicons do not yet contain sufficient minimal pairs to explain this phonetic categorization. Therefore, researchers focused on a bottom-up mechanism: infants learn sounds through their sensitivity to the frequency distributions of sounds in their input (Maye, Werker & Gerken, 2002). Recent evidence shows that this bottom-up mechanism may be complemented by the acoustic or visual contexts in which speech sounds occur.

To test this hypothesis, we investigated whether discrimination of a non-native vowel contrast improves when sounds from the contrast were paired consistently or inconsistently with two distinct objects. This was assessed in two ways: computationally, in a neural network simulation, and experimentally, in a group of 8-month-old infants. Because the distribution of sounds suggested one broad category (one-peaked distribution), the interplay of semantic and distributional cues on learning could be evaluated.

The neural network was trained to 10.000 repetitions of the sound-object pairs. Only in the consistent condition, two vowel categories emerged. For the infants (n=49), the training phase was just 128 sound-object pairs (total of 2.5 minutes). The test phase comprised alternating vs. repeating test trials of the sounds without the visual context (Best & Jones, 1998). There was an effect of semantic cues only in the group that had larger vocabularies at 18 months (p = 0.016); infants in the consistent condition but not in the inconsistent condition showed successful learning of the vowel contrast.

Both approaches suggest that visual context can shape phonetic categorization. This effect of semantic cues appears to be more profound in infants whose vocabularies develop faster.

Asymmetry in English infants' ability to discriminate an Urdu voiceless affricate contrast

Mariam Dar

University of York, UK

There is ample evidence to show that infants are born with 'universal' listening abilities that allow them to successfully discriminate most of the phonological contrasts of the world's languages. However, exposure to the ambient language results in a developmental decline in discrimination of non-native contrasts. Whereas 6-8-month-old infants are able to discriminate non-native speech sounds that adults cannot discriminate, by 10-12 months the infants are no longer able to do so (Werker et al., 1981). The current study further explored this developmental change, using an Urdu affricate contrast /tʃ/ - /tʃʰ/ which had not previously been tested on English infants. Thirty 7-month- and thirty 11-month-olds were tested in a habituation procedure. Half of the infants were habituated to the aspirated and tested on the contrasting unaspirated affricate while the remaining infants experienced the reverse pattern of exposure. Discrimination was assessed by comparing mean pre-shift looking time to mean post-shift looking time. The results indicated that the younger group could discriminate the affricate pair while the older group had a marginally significant difference (p = .1) in looking to the changed stimulus. Further analysis revealed that the 11-month-olds showed better performance only when the aspirated stimulus /tʃʰ/ was presented first, with successful discrimination for this order of presentation. The experiment was replicated with the older group of infants when they reached 15 months of age, with essentially the same result. Both studies provide clear confirmation of an order effect in consonant discrimination. In contrast, English adults (N=20) failed to discriminate the affricate pair in an AX discrimination task and also showed no order effect. The implications of these studies for infant consonant processing more generally, and for the course of development from infant to adult, will be discussed.

From rigidity to flexibility in infants' prosodic processing

Linda Garami, Anett Ragó, Ferenc Honbolygó and Valéria Csépe

MTA RCNS Brain Imaging Centre, Hungary

Infants acquire their native language quickly under non-segmented conditions, where word-like segments may emerge without any lexical knowledge. Infants seem to derive the native language-specific patterns from the rhythmic regularities contributing to segmentation of the first units. This special sensitivity to regularities enables infants to tie their detection to linguistically relevant patterns. As the electrophysiological (mismatch negativity) data of Honbolygó and Csépe (2013) showed native Hungarian adults detected word and pseudo-word stress as language-specific pattern of long-term and pre-lexical in nature, similar ERP changes recordable in infants (Ragó et al, 2014) allow us to follow how these regular templates of fix assignments of the salient syllable emerge during the first year of life.

In this study the same passive odd-ball paradigm (pseudo-word 'be-be', stress deviant's p=20%) was used in 6-10 month-olds (N= 49) as in adults. The main variables used were legality (legal vs. illegal pattern) and condition (standard vs deviant role) giving four variations measured in separate blocks. Our data revealed that infants similarly to adults showed a robust response to the illegal deviant and not to the legal one. This suggests the presence of a pattern-based processing of word stress. However, striking differences were found between the infant and adult type of detection; (1) adults differentiated between the legal and illegal stimuli as deviants but not as standards (2) while legal and illegal stimulus elicited significantly different ERPs already as a standard stimulus among infants. Our interpretation is that while adults can adapt more flexibly to word stress representation, infants hold rigid expactations of those during development. This hinders them to rely on the illegally stressed stimulus as a standard. Our ongoing studies are designed to answer the question how these templates develop further in a language with no lexical stress.

Early word forms in production and in perception: The role of geminates

Marilyn Vihman[1] and Marinella Majorano[2]

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Early words produced in languages with word-medial geminates, like Finnish or Italian, tend to coalesce around the geminates: Their slow articulation is easy and their duration makes for perceptual salience. Child onset-consonant omission is also common here, even under initial-syllable accent. We tested the hypothesis that the medial geminates' salience detracts from child attention to word onset.

Experimental studies have shown that by 11 months infants recognize untrained word forms familiar from everyday life. However, we observe cross-linguistic differences: Change to the onset consonant has a larger effect in English, with initial-syllable stress, than in French, with second-syllable accent. If medial geminates may lead to <VCCV> word representations, Italian infants should recognize such words even if with changed onset in the accented syllable.

Three experiments tested 11-month-olds (20-21 each). In (baseline) Exp. 1 isolated words likely to be familiar (bello 'beautiful') were contrasted with formally similar words unlikely to be familiar (flotta 'fleet'). The infants responded more to the familiar words. In Exp. 2 all words had a medial geminate, but with changed onset consonant. Infants responded to the familiar words despite the changes, suggesting that the word shape as a whole affected word recognition, given the infants' diminished attention to the onsets. Exp. 3 changed the onset in medial-singleton words. Here infants failed to respond more to the familiar words, showing sensitivity to onset change when no geminates occur later.

The findings thus support the English and French evidence that not all aspects of a word are equally well represented. Perceptual salience of an element later in a word may account for the common omission of the onset consonants, also seen in iambic languages.

Active functional networks in neonates while segmenting speech using statistical information

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SISSA, Italy

Computing statistical information between syllables is a mechanism proposed for speech segmentation and it is an open question if and how newborns can use these cues to extract words. In Experiment 1 we addressed this using NIRS. Newborns (N = 40) were familiarized to 220 seconds of continuous speech built using 4 3-syllabic words, repeated randomly, and the changes in HbO and Hb during test blocks were used as a measure of novelty detection of parts vs words. Infants showed a differential change in fronto-temporal channels (p < .05), suggesting they extracted the words.

In addition we ran a connectivity analysis along the familiarization focused in how the functional networks evolve. The networks found comprised mostly frontal and temporal channels, and interestingly we found an increase in the density (p < .05) along the familiarization, mainly in inter-hemispheric and left-hemisphere connections. Furthermore, the difference in activation for part-words and words, in frontal-left regions, was negatively correlated with the increase in density, and positively with the small word index –a measure of integration and segregation. This suggests that an early increase in connectivity and an optimization of the communication between modules, predicts performance.

In Experiment 2, we ran connectivity analyses on neonates (N = 15) exposed to a statistical information stream (SI), a stream of random syllables (Rnd), and silence (Sil). In the SI condition there was a change in the inter-hemispheric and left-hemispheric density; in the Rnd condition in total density; whereas no change was found in the Sil condition. Moreover the mean correlation coefficient showed the pattern SI > Rnd > Sil.

Our findings show 1) That neonates can compute stats and extract 4 different words 2) A functional change while performing a task 3) A correlation between it and performance during tests 4) A higher connectivity during an active task compare with the "default network" (Sil condition).

Perceptual abilities in relation with motor development in the first year of life

Marjorie Dole[1], Hélène Loevenbruck[2], Olivier Pascalis[2], Jean-Luc Schwartz[1] and Anne Vilain[1]

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To better understand the development of perceptuo-motor interactions during the first year of life we designed two studies evaluating the influence of speech production abilities on phonemic categorization.

In a first study we use a visual fixation paradigm to evaluate infants' consonant categorization in different vowel contexts. Auditory stimuli are presented via a loudspeaker located behind a screen. A /d/-/g/ contrast is employed; infants are habituated with one member of the pair associated with different vowels (/do/-/di/-/du/). When reaching the criterion of 60% of the mean looking time (LT) for the first three trials, they are presented with consonants in a new context (/da/ and /ga/). We compare LTs between familiar and novel consonants. Infants who are able to extract the common consonant (here /d/) in the different vocalic contexts should show different LTs for the two test stimuli.

In a second study infants' ability to link auditory and visual information on a consonant category into a single representation will be tested using an intersensory matching procedure. Infants will be familiarized with auditory syllables with different vowel contexts (/bo/-/bi/-/bu/). In the test phase, two side-by-side silent videos of faces repeatedly pronouncing consonants in a new vowel context (/ba/ on one side and /da/ on the other) will be presented and LT to each video will be compared. Infants who are able to extract the common gesture in the audio syllables should be able to relate it to the same gesture in the visual stimuli and show different LTs for the two test stimuli (/ba/vs/da/).

For both studies the speech production abilities of each of the 6- to 12-month-old infants are assessed using a parental questionnaire. We expect better categorization and better auditory-visual association in infants who can produce the target consonants than in those who cannot. These studies will allow us assess the role of motor knowledge in the development of speech perception.

Indexical and linguistic processing in infancy: Discrimination of speaker, accent and phonemic differences

Paola Escudero[1], Karen Mulak[1], Cory Bonn[2] and Richard Aslin[2]

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Infants discriminate native speech sounds prior to acquiring lexical knowledge. It is still unknown how infants extract the vowel phonemes of their language from distributional information in the presence of large between-speaker variability in vowel realizations. Infants can discriminate speech sounds and recognize words produced by different speakers, but struggle with productions in an unfamiliar accent. What we do not know is the relative salience of indexical and linguistic cues in infant speech processing.

We tested discrimination of speaker, accent and phonemic changes in 73 13 months-old infants (37 Dutch and 36 English) using instances of the Dutch vowels /ɪ/ and /ɛ/ɛ spoken by two females of North Holland Dutch (NH1, NH2) and one of East Flemish Dutch (EF). Infants heard 8 familiarization trials with /ɪ/ produced by NHD1, followed by three test trials. Trial 1 was the same as familiarization (same), while Trial 2 had /ɪ/ and /ɛ/ spoken by NHD1 (vowel change). For Trial 3, 35 infants heard tokens of /ɪ/ from NHD1 and NHD2 (speaker change), while 38 infants heard tokens of /ɪ/ from NHD1 and EFD (accent change).

A repeated-measures ANOVA on difference scores between looking times to test trials and the last two familiarization trials with test trial as the within-subject variable and with native language and test trial 3 as between-subjects factors revealed a main effect of test trial. Planned paired comparisons confirmed that infants had a larger difference in looking time for the vowel change and speaker/accent change trials than for the same trial, but looking time did not differ between vowel and speaker/accent change trials.

Our results show that infants notice linguistic and indexical differences in vowels, suggesting that they are able to distinguish the same type of information as adults. Further research should explore whether they, like adults, ignore indexical differences in a more linguistic task such as vowel categorization.

Infants' sensitivity to rhyme in songs

Laura Elisabeth Hahn[1], Titia Benders[2], Tineke M. Snijders[1] and Paula Fikkert[1]

[1]Radboud University, Netherlands; [2]Newcastle University, Australia

Various situations of infants' daily lives are accompanied by songs that rhyme. Earlier research, using spoken words, has not been equivocal on infants' sensitivity to rhymes (see Juszczyk et al., 1999, but also Hayes et al., 2009, 2000). We hypothesized that the use of songs would boost infants' sensitivity to rhymes (Lebedeva & Kuhl, 2010).

We created simple melodies and lyrics in Dutch jabberwocky, containing Dutch function words and legal non-words. To obtain rhyming and non-rhyming (control) songs, we altered the final word of each phrase, while using the same set of words over all songs. This resulted in songs with phrase-final words that rhymed or did not rhyme.

9-month-old infants were exposed to rhyming and control songs, counterbalanced across two blocks. Based on a power analysis we aimed at testing 30 infants for a power of 0.8. So far data from 18 infants has been analyzed (mean age: 297 days, 14 female), while an additional 12 infants were excluded due to fuzziness. We analyzed looking times from the moment rhyme and control songs differed (after the first two phrases). In the preliminary analysis we found no effect of rhyme (mean (SD) of total looking times in seconds, rhyming songs 5.56 (5.54); control songs 6.31 (5.55); p>.05. We will repeat the analysis once a sample of 30 good data sets has been collected.

Results of a parental questionnaire suggested the infant participants hear rhyming songs on a daily basis. Nevertheless, they do not seem to have a preference for these songs. One possibility is that our sample of participants is yet too small, or our method not sensitive enough. By using a more subtle method in the future, we might be able to pick up infants' responses to the difference between rhyming and non-rhyming songs. The data so far suggests however that rhymes are only detected at a later age.

Discrimination of lenis and aspirated stop contrasts among Korean infants

Minji Nam[1], Youngon Choi[1], Naoto Yamane[2] and Reiko Mazuka[2]

[1] Chung-Ang university, Korea; [2] RIKEN Brain Science institute, Japan

A growing body of research suggest diverse developmental patterns in reorganization of infants' phoneme perception during the first year (Mazuka, Hasegawa, & Tsuji, 2014). While many studies showed that infants discriminate many native and nonnative speech sounds from birth and until about 10 months, (Eimas et al., 1971; Kuhl et al., 2006; Werker & Tees, 1984), recent studies have shown that discrimination of certain contrasts require early linguistic experience (Narayan, Werker, & Beddor, 2010; Sato, Kato, & Mazuka, 2012). Korean has 3-way obstruent contrasts (lenis, fortis, & aspirated) that are known to be difficult to distinguish for nonnative speakers, especially the pair of lenis and aspirated stops (Broersma, 2009). No studies thus far have examined infant's developmental pattern of these sound pairs. The present study looked at whether the ability to discriminate aspirated and lenis stops is present from birth or developed via early linguistic experience. We tested 11 Korean-learning 4–6.5-month-olds and 14 10–12-month-olds using a visual habituation-dishabituation paradigm with [pu] (lenis) and [phu] (aspirated). Also, additional 20 of 3.5–6.5-month-olds were tested with a highly distinctive phoneme pair, [k'al] vs. [mim]. Ten–12-month olds looked significantly longer during switch trials than same trials, showing that they discriminated the two contrasts (t(13)=2.16, p=.05). By contrast, 4–6.5-month-olds' looking times were similar between the two trials, suggesting that they might not yet be able to distinguish the contrasts (t(10)=-.14, p=.89). However, the same age control group did not have any difficulty with discriminating [k'al] from [mim] (t(19)=2.49, p=.02). The data collection is still on-going, but the pattern of results so far suggests that the lenis and aspirated stops of Korean may require early language exposure for infants to become able to discriminate these sounds, similar to Filipino nasal contrast and Japanese geminate obstruent.

Development of sound-shape correspondence effect

Jovana Pejovic[1], Monika Molnar[1], Clara Martin[1] and Eiling Yee[2]

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Behavioural investigations have shown that young infants can already match auditory and visual information from both linguistic and non-linguistic sources (e.g., sound symbolism). This matching ability is typically thought to reflect cross-sensory integration and to rely on developing connections between the auditory and visual areas of the brain. However, anatomical studies suggest that such inter-cortical connections do not begin to develop until after 6 months of age. To reconcile these reports, we assessed adults' and infants' sensitivity to sound-shape correspondence. In Study 1, we tested monolinguals (Spanish) and bilinguals (Spanish-Basque and Spanish-Galician). The effect was found in all groups, however the effect was the largest in the group with Basque experience. This is in line with previous findings suggesting that experience with a language that is rich in sound symbolic words (e.g., Japanese or Basque) enhances sensitivity to sound symbolism. In Study 2 and 3, using a behavioural auditory-visual matching paradigm, we tested 4- and 12 month-old infants' sound-shape matching biases using different sets of non-words. At 4 MOA infants showed no evidence for sound-shape correspondence. Infants at 12 MOA exhibited the effect, however (unlike in adults), it did not vary as a function of Basque experience. Overall, no evidence for sound-shape correspondence in young infants was present, however the effect was present in older infants. Additionally, exposure to sound-symbolic language plays a role in adults, while in infants the effect relies more on general multisensory development.

The nature of the universal trochaic bias: Dutch-learning and Turkish-learning infants

Brigitta Keij

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In this study we compare infants learning rhythmically opposing languages, namely Dutch-learning infants (SW pattern, like English) and Turkish-learning infants (WS pattern, like Hebrew). Do Dutch- and Turkish-learning infants show a native rhythmic preference and if so, at what age? In an innovative looking-while-listening eye-tracking procedure infants are presented with a single pseudo-word spoken by a speaker of a third language. In total, 90 Dutch-learning and 90 Turkish-learning infants aged 4, 6 and 8 months were tested. The Dutch-learning infants show a SW preference, which is strongest at 6 months. The Turkish-learning infants also show a SW preference, which is strongest at 4 months. These results could be interpreted as evidence for a universal trochaic bias. However, we interpret the results in light of a study investigating Hebrew-learning infants at 9 months (Segal & Kishon-Rabin, 2012). This study shows that Hebrew-learning 9-month-olds demonstrate a native WS preference when listening to a speaker of Hebrew. But when listening to a speaker of English, Hebrew-learning infants showed a SW preference. Consequently, it seems to matter whether infants are listening to a speaker of their native language. We propose that infants resort to a 'default' universal trochaic bias, when they listen to a speaker of a foreign language. Therefore, we would like to propose a native language dependency hypothesis. Thus, adequate testing of native rhythmic preferences requires a speaker of the native language. In this paper we present a follow-up study testing 48 Dutch-learning and 48 Turkish-learning infants at 6 and 8 months with a native language speaker in an otherwise similar procedure. The results present us with a replication of our earlier results from the experiment with a foreign language speaker. This suggests that there is no influence of the native language of the speaker the infants are listening to, at least not for these language and age groups.

Social factors of language development

Poster session 1

Wednesday, June 10, 15.30

The interaction of three-year-old siblings in twin pairs' home language environment

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Language environment is the major factor for twins' higher risk for speech and language delay (for review, see Thorpe, 2006). Twins, for example, share the parental attention and spend lots of time with a person of same developmental level. Having a sibling can change language environment (e.g. Rutter et al., 2003). Besides caregivers, older siblings can be important contributors to child's cognitive development (Azmitia & Hesser, 1993). Little research to date has considered could older siblings be an additional resource of interaction for twins.

This cross-sectional multiple case study describes the interactional resources that two Finnish three-year-old sisters offer their seven-month-old twin siblings. The day-long recordings were gathered by using LENA™ digital language processors in twins' natural home environments as a part of a wider Finnish twin child language research. For this study, 45 minute samples were selected. The selection was based on LENA™ reports on activity of siblings' speech.

Mother-directed and sibling-directed speech turns are identified and counted from the samples and the turns will be categorized and compared by applying the child's models of language (Halliday 1973, 11-17). The results will be discussed in light of earlier research of family interaction and early language acquisition.

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Halliday M. A. K. (1973). Explorations in the functions of language. London, Arnold.

Rutter M., Thorpe K., Greenwood R., Northstone K. & Golding J. (2003). Twins as a natural experiment to study the cases of mild language delay: II: Family interaction risk factors. Journal of Child Psychology and

Psychiatry 44, 342–355.

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How to learn the deictic shift through observation?

Franziska Krause and Katharina Rohlfing

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In their second year of life toddlers often reverse deictic symbols, for example talking about I when actually addressing the caregiver. In order to understand to which entity a deictic symbol refers, toddlers need to realize that signs have a bidirectional character. Therefore, they have to switch roles in dialogue and address the symbol to the communication partner instead of themselves; this is known as role reversal imitation. Since children initially acquire their first symbols mostly in dyads with their mothers, from the middle of the second year on they are also able to learn in triadic contexts through observation. This bystander's perspective presumably allows a holistic view on deictic symbols, which could be advantageous for understanding the deictic shift.

In the present study we compare the influence of triadic and dyadic learning contexts on the deictic shift in 18-20-month-olds. We hypothesize that the triadic context is beneficial for childrens' ability of role reversal in symbol use. For verifying our hypothesis we trained children in very concrete scenarios including actions, which function as pronouns you and I. You-actions always referred to the addressee, whereas I-actions had their endpoint on the self. In the triadic condition children could observe actions, which presented the deictic shift of symbols, whereas children in the dyadic condition learned in a comparable 1:1 situation. Additionally, one group of children were presented actions with accompanying novel pronouns, emphasizing the referential end point.

Data were coded independently by two raters focusing on the amount of reversed symbol use. Preliminary analyses indicate an advantage of the triadic learning context over the dyad. Children imitate the actions significantly more frequently with shifted roles regardless of pronoun use. The ability to adopt another perspective which is fundamental for understanding deictic words in particular, seems to play a key role in this respect.

Do language-like vocalizations (child-directed attention getter and onomatopoetic sounds) enhance infants' action segmentation?

Silke Fischer and Katharina J. Rohlfing

CITEC, Bielefeld University, Germany

In learning about action and language the environment provides infants with a stream of events. The detection of its relevant components and its segmentation into meaningful units is a challenging task for infants. Yet, it is fundamental for verb learning which is far more difficult and occurs later in development than learning nouns (e.g., Golinkoff & Hirsh-Pasek, 2008).

In infancy, research focuses mainly on detection of action components that is assumed to be the basis for later linguistic concepts of verbs: E.g. spatial relations (as containment or support relations, "in" or "on") or path and manner relations: a path depicts a movement of an object in relation to the ground (see Pruden et al., 2013) whereas manner describes the way of motion, for example "jumping" or "rolling". Sensitivity for these events emerges at different stages in development. So, infants identify spatial relations in an action stream already at 8 months but not manner (Hespos, Saylor, Grossman, 2009) which is recognized only at 13 months (Pruden et al., 2012).

However, the role of linguistic cues for segmentation of those components has not been extensively investigated until now: labels have been found to facilitate path categorization but the mechanism stays unclear (Pruden et al., 2013) – do labels just enhance the saliency of the path or provide more information?

In two habituation studies, we investigated the effects of different linguistic input on action segmentation and recognition of manner in 8-month-old German-learning infants: we presented action events with different child-directed vocalizations ("Oh") and onomatopoetic sounds (Asano et al., 2015).

Our preliminary results indicate a higher infants' sensitivity about onomatopoetic sounds over child-directed vocalizations, thus underlining not only the importance of linguistic cues for action segmentation but also shedding light into the nature of the linguistic content as an important precursor of verb learning as such.

Neurodevelopmental aspects of language acquisition

Poster session 2

Thursday, June 11, 13.00

Mapping vowel development in infancy: Multidimensional scaling of English vowels based on cortical auditory evoked potentials

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Studies on phonetic development have focused on individual phonetic contrasts (e.g., /i/-/y/), because collecting data on even a single contrast is very time intensive. The present study used a more time-efficient measure of perceptual sensitivity, which allowed us to map perception across an entire British English vowel space for 80 monolingual English infants (4-5, 8-9 and 10-11 months old). Auditory evoked potentials were measured for spectral changes between concatenated vowels, which, for infants, typically evokes a positivity about 150-200 ms after each spectral change. These were measured for 28 pairs of seven monophthongal vowels (/i/, /ɪ/, /ɛ/, /a/, /ɑ/, /ɔ/, /u/) that were presented in a random concatenated sequence with changes every 300-400 ms. ERPs were averaged across epochs following each spectral change, with the magnitude of the response for each vowel pair used as similarity measure for multidimensional scaling. The 4-5 month old infants had two-dimensional perceptual maps that closely matched the F1 and F2 acoustic differences between vowels. However, the older infants (8-9 and 10-11 months) had maps that were less related to acoustic differences, and seemed affected by the emergence of phonological categories (e.g., selectively higher responses for spectrally similar vowels, such as /i/-/ɪ/). These results verify that this technique can successfully map the perceptual sensitivities of infants with more detail than previous methods, and suggest that this neural response is sensitive to both auditory processing and language-specific phonological development.

Resting state connectivity following exposure to Chinese: The case of international adoptees

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Over their first year, infants are thought to experience an optimal developmental period during which native language sound categories are formed (e.g., Kuhl et al., 2005). For internationally-adopted (IA) children, however, this period is disrupted as children are exposed to a birth language, but are adopted into families whose language differs. Previously, we have shown that IA children retain neural representations for their birth language, despite its complete discontinuation at a very young age (Pierce et al., 2014). In the present study we examined whether this early language experience also leads to activation of resting state connectivity networks that reflect this early exposure. To test this, we scanned 3 groups of 9-17 year old participants using BOLD fMRI (n = 10 per group): (1) IA participants from China, adopted into French-speaking families (mean age of adoption: 12.8 months), who now speak only French; (2) children who learned Chinese from birth, began learning French as an L2 at the same age as the IA group, and now speak Chinese and French; and (3) French monolingual children who were exposed only to French since birth. We were interested in whether resting state connectivity networks associated with the processing of Chinese lexical tone differed across groups, as these IA children showed native-like activation to lexical tone in a previous analysis. Thus, we performed a resting state analysis using the previously activated region, left planum temporale (PT), as a seed region. Present results showed more extensive connectivity at rest between left PT and several right hemisphere regions for both the IA children and bilinguals in comparison to French monolinguals. This suggests recruitment of a more extensive network for these groups with early tonal language exposure, even when no specific task is being performed. This occurred despite the fact that IA children discontinued Chinese, suggesting a lasting impact of this early experience.

Syllable stress does not determine how detailed six-month-olds process phonemes

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Recent electrophysiological research on infant speech processing has shown that six-month-olds (i) seem to selectively focus on phoneme-relevant information of the signal by neglecting prosody-relevant information (Becker, Schild, Friedrich, 2014), and (ii) process phoneme-relevant information rather holistically than detailed (Teickner, Becker, Schild, Friedrich, 2014). In the light of our results we argued that independent processing systems for phoneme-relevant information and prosody-relevant information are established in infancy. Here we further investigate this assumption.

We presented six-month-olds with disyllabic German words as targets and their first syllable as primes. We manipulated the primes on both phoneme level (complete match, one feature mismatch, complete mismatch between primes and targets) and stress level (stressed vs. unstressed primes). We replicated our former results: Six-month-olds do not show stress priming and do not notice subtle phonemic variation between primes and targets. Furthermore, there was no interaction between both factors.

The present results show that syllable stress does not determine how detailed six-month-olds process information on the phoneme level. Regardless of stress, six-month-olds rather seem to focus on rough commonalities between phonemes than on subtle differences between them. Together the results support our assumption of independent processing systems for phoneme-relevant information and prosody-relevant information.

Electroencephalographic and hemodynamic correlates of infant hierarchical rule learning

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The ability to process hierarchical grammar structures is crucial for human language. However, it is still unclear when and how during development this ability is acquired. From previous research [1] we know that 3-month-old infants are able to process simple dependency rules between non-adjacent elements, which is a prerequisite for the ability to process hierarchical structures involving embedded rules. We investigated whether 5-month-old infants are able to process hierarchical rules. We used a passive listening oddball paradigm with 5-tone sequences as oddball elements, in which double center-embedded rules were incorporated. In a combined EEG-fNIRS data acquisition, EEG provides us information on whether the infants are able to process the hierarchical rules, whereas fNIRS delivers insights into the involved cortical regions. The EEG results show negative infant mismatch responses, indicating that the infants successfully processed the hierarchical rules. The fNIRS results reveal bilateral frontal and temporal activation patterns. Our study suggests that by 5 months of age, infants are able to process hierarchical rules between non-linguistic auditory elements and recruit both temporal and frontal regions for rule deviance detection.

[1] Mueller, J. L., & Friederici, A. D., Männel, C. (2012). Auditory perception at the root of language learning. PNAS, 109(39): 15953–15958. doi:10.1073/pnas.1204319109/-/DCSupplemental

Two-year-olds' knowledge of verb argument structure: Evidence from ERP

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Languages contain systematic mappings between structure and word meaning (Levin& Rappaport,2005). Verbs referring to causal events appear in transitive sentences (I gorp him). A rich literature documents infants and children sensitivity to the correlation of verb meaning and syntactic properties, and their use to constrain interpretation, a process known as syntactic bootstrapping (Gleitman,1990). If a verb occurs in a transitive sentence, two-year-olds expect it to refer to a causal event(Naigles,1990). Language acquisition literature has typically focused on causal-transitive relationship. Yet, syntactic bootstrapping is not limited to that(Ambridge et al.,2012).

We investigate whether toddlers are aware of other mappings involving complex structures. In particular, we focus on transfer and communication verbs to test whether children predict syntactic structures on-line. For instance, a communication verb can take a proposition "I say that Tom can swim", a transfer verb can take 3 arguments (giver/ givee/ object given), but not a proposition. We used an innovative ERP design to measure perception of grammaticality (Bernal et al, 2010; Friedrich&Friederici, 2004).

French toddlers (currently n= 10, 23.5-24.5 months) watched films, while brain activity was recorded. Each film had ungrammatical (*Thomas gives her that he likes cake), and grammatical sentences (Thomas gives her a cake/ Thomas tells her that he likes cake). If toddlers expect syntactic structure to match semantic properties, then they should present different brain responses to test sentences.

The ungrammatical condition presented a central-negativity in a 250-650ms time-window (t(1,9)=2,78 p=0.02), not found in grammatical conditions. Results suggest toddlers treat these types of sentences differently and compute expectations about syntactic structures and verb. This implies that they already know in which syntactic structures different verbs may occur, in line with the syntactic bootstrapping proposal.

Audiovisual speech perception is influenced by infants' vocal productivity and their attention to visual speech cues

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Studies suggest that articulatory abilities (Mugitani et al., 2009; Yeung & Werker, 2013) and attention to visual speech cues (Lewkowicz & Hannsen-Tift, 2012; Kushnerenko et al., 2013) modulate speech perception and foster language learning. Brain imaging studies further indicate that infants increasingly recruit regions in the inferior frontal cortex associated with speech motor planning during speech perception (Dehaene-Lambertz et al., 2006; Imada et al., 2006; Kuhl et al., 2014). One might suppose that increased mouth looking is linked to more advanced productive abilities and stronger activation of motor regions during speech perception, but it is unclear if and how these factors are linked.

We tested 5.5- to 6-months-olds' activation of frontal brain regions during speech perception using fNIRS. The first study presented native vowels in different modalities; the second study used vowels for which auditory and visual speech cues either matched or mismatched. Infants' preference to look at the speaker's eyes and mouth was measured in an eye-tracking task and vocal productivity was assessed through a standardized questionnaire.

Results show activation of a wide-spread frontal network in response to speech, including areas in the prefrontal cortex associated with processing of communicative signals (Grossmann et al., 2010) and areas in the inferior frontal cortex. Frontal activation was modulated by (a) the match between auditory and visual speech cues, (b) by infants' vocal productivity, and (c) by their preference to look at the speaker's mouth. Specifically, activation for speech tends to be left lateralized, with stronger activation in left frontal regions for those infants that babble more and prefer to look at the speaker's mouth. This suggests that behavioral markers of language development, such as higher vocal productivity and more mature looking patterns, are related to the recruitment of frontal brain regions during speech perception in infancy.

Atypical language development

Poster session 2

Thursday, June 11, 13.00

ERPs of lexical-semantic integration in language-impaired preschoolers

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Research question: To understand the meaning of a spoken sentence, words must be accessed and linked together, which is a relatively complex process. We investigated whether preschoolers with a specific language impairment (SLI) have difficulties with lexical-semantic integration underlying spoken sentence comprehension. We compared the time course and characteristics of lexical-semantic processing in a large group of preschoolers with SLI and a group of typically developing (TD) peers using the N400 as marker for lexical-semantic integration.

Methods: ERPs of 37 preschoolers with SLI and 25 TD peers were included. Language-impaired children had receptive-expressive language problems, or expressive language problems only. Children listened to sentences that ended with a semantically congruent word (My father is eating an apple) or a semantically incongruent word (My father is eating a blanket). Prior to to ERP experiment, children were assessed on language abilities with a battery of standardized tests.

Results: The SLI group showed a reliable N400 effect like the TD group, but it occurred later and was less focalized than in the TD group. In the SLI group, a weaker N400 was associated with lower language skills. After a post hoc split of the SLI group, only the subgroup children with expressive language problems showed a later and less focalized N400 effect, while the subgroup children with receptive-expressive language problems appeared not to be sensitive to lexical-semantic manipulations at all.

Discussion: These results suggest that language-impaired children, at least those with expressive language problems, are able to link words together as the sentence unfolds to arrive at a sentence meaning, though this process seems to occur less quickly and less efficiently than in TD children. Possible explanations are impaired (working) memory, more specific fast decay of lexical representations, or impoverished lexical representations in particular for verbs.

Application of ICF-CY in the assessment of Iranian children with primary developmental language disorders (PDLD)

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Background: The main objective of the International Classification of Functioning, Disability and Health- children and youth version(ICF-CY), is to provide a unified terminology among the health professionals in the field of children up to 18 years of age. This framework describe children's health status within several domains including body structure/functions, participation, activities, environmental and individual factors.

Due to the lack of standard language assessments in speech therapy clinics in Iran for children with PDLD (specified with unknown etiology for language impairment, Paul & Norbury, 2012), this study sought to determine the extent of compatibility of these assessments with the ICF-CY framework and with evidence-based (EB) diagnostic principals.

Methods: Content analysis was used as the main procedure of data analysis in this mixed method study. The assessment profiles of children with PDLD were screened retrospectively to extract those major themes that Iranian speech therapists (STs) examine during a routine assessment. The themes were compared to ICF-CY codes and evaluated against the criteria of an EB diagnosis by seven qualified STs in a focus group, prospectively.

Results: Five out of nine themes were compatible with ICF-CY framework. The focus group evaluated 59 codes (out 61) as essential to be allocated in an EB assessment. The compatibility of these codes with EB diagnostic tools will be discussed.

Conclusion: The majority of assessment domains implied by Iranian STs to assess communication abilities of children with PDLD conform to ICF-CY codes. The diagnostic accuracy of these tools, however, needs to be assayed using an evidence-based practice (EBP) approach.

Key words: ICF-CY, EBP, assessment, primary developmental language disorders, children

Paul, R., Norbury, C. (2012) Language disorders from Infancy through adolescence. St. Louis, Missouri: Elsevier, Mosby.

Brain plasticity in language networks revealed using structural and functional connectivity in a 3 years-old child with left perinatal stroke

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Brain imaging methods have largely contributed to shed light on the possible mechanisms of recovery and cortical reorganization after early brain insult. The idea that a functional left hemisphere is crucial for achieving a normalized pattern of language development after left perinatal stroke is still under debate. Here, we report an interesting case of a 3 year-old child born at term with a left perinatal ischemic stroke of the left middle cerebral artery, affecting the superior temporal gyrus and extending to the supra-marginal gyrus. We evaluated the child for cognitive, social and linguistic abilities at 3 years of age. Linguistic learning abilities were also assessed using a fast-mapping task adapted for preschoolers and mimicking the first steps of language acquisition. Moreover, we acquired functional and structural imaging data as well as a measure of intrinsic connectivity. Despite having linguistic receptive functions within the normal range, the child had clear difficulties in the productive aspects of language, was impaired in learning new word-referent associations, showed a right lateralized pattern of BOLD activation during a passive listening task and had a disrupted left arcuate fasciculus. These data suggest an important role of the left hemisphere and specifically of the arcuate fasciculus for the learning of novel word-referent associations, one of the building block of vocabulary acquisition.

Language acquisition and cognition

Poster session 2

Thursday, June 11, 13.00

Individual differences in object-processing explain relation between gaze following and vocabulary size

Yuko Okumura[1], Yasuhiro Kanakogi[2], Tessei Kobayashi[1] and Shoji Itakura[2]

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Gaze-following behaviors play an important role in language acquisition (Tomasello, 1995; Brooks & Meltzoff, 2005). However, it remains unclear how gaze following contributes to language acquisition. Gaze-following behavior includes two abilities: attending to the gaze direction of others and processing the cued object based on comprehension of the referential gaze (Okumura et al., 2013). In the present study, we investigated how these two influences work together to promote language development in a longitudinal study on infants from 9 to 18 months of age.

Nine-month-old infants (n=37) were shown videos in which a model gazed at one of two objects. Following this phase, the infants were presented with the two objects in the object-processing test. When they were 18 months old, we collected their comprehensive vocabulary size through the McArthur CDI. Our result indicated that the infants at 9 months looked significantly longer at the cued object than at the uncued object (t(36)=2.92, p<.01), showing gaze-following behaviors. In the object-processing test, the proportion of time looking at the cued and uncued objects did not differ significantly (t(36)=1.08, p>.05), indicating object-processing ability during the developmental transition at this age.

Next, we used mediation analysis: (i) gaze following is related to vocabulary size, r=0.33, p=.05; (ii) gaze following is related to object-processing efficiency, r=0.40, p<.05; and (iii) object-processing is related to vocabulary size, r=0.54, p<.01. Finally, the relation between gaze following and vocabulary size was reduced from 0.32 to 0.13 when the object-processing performance was included in the model (Sobel test, p<.05), which indicates that object-processing efficiency mediates the relation. Our findings elucidate a critical step in language development and suggest that gaze following promotes vocabulary development via its influence on object-processing efficiency.

The acquisition of audiovisual cues to uncertainty

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Uncertainty can be encoded through various verbal and nonverbal means (e.g. lexicon, prosody and gesture). Previous studies concentrated on the role of lexical cues in the understanding of uncertainty while less is known about the role of prosody and gesture patterns. Studies on phonological development reported an early infants'use of prosodic cues for pragmatic purposes prior to their ability to access lexical information (e.g. Snow, 2006). Also, facial gestures have been shown to provide children with the scaffolding to linguistic meaning (Armstrong et al.,2014). The present study addresses the following research questions: How do children better detect uncertainty,(1)through gestures or the lexicon?(2)through gestures or prosody?

Ninety 3- to 5-year-old Catalan-dominant children are tested in one of two experiments. The experiments consist of a Powerpoint presentation in which two pairs of twins are guessing a third-character's favourite things. One of the twins knows the answer and the other one is unsure. The children have to guess the latter. While in Exp. 1, the uncertainty meaning is expressed through lexical cues (modal verbs), in Exp. 2 it is expressed through a rising intonation contour and both experiments are accompanied by a facial expression of uncertainty. The trial types are audio-only, video-only and audio-visual.

Preliminary results from 47 children suggest that contrary to previous results, children start to recognise uncertainty as early as age 3. Comparing results of the two experiments, it can be seen that children perform better when they have prosodic and gestural cues at hand. They seem to provide children with the scaffolding for linguistic meaning of uncertainty.

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Snow,D. (2006). Regression and reorganization of intonation between 6 and 23 months. Child Development, 77, 281-296.

Links between musical and linguistic abilities in preschoolers: The role of the family's musical environment

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An increasing body of literature appears to indicate that powerful links exist between music and language. Such links have been extensively examined in adults and school aged children with many studies relating linguistic advantages such as verbal memory (Franklin et al., 2008), phonological awareness (Moritz et al., 2012) and syntax processing (Jentschke & Koeschl, 2009) to years of musical training. Relevant research in preschoolers is rather limited to children ≥ 4 years and typically explores links between single linguistic and musical aptitudes (e.g., rhythm synchronization and speech encoding; Woodruff-Carr et al., 2014) rather than evaluating a wide range of linguistic skills. Studying children younger than 4 years old is central, as it sheds light on possible ways to facilitate language acquisition and development at an age when the brain is still highly plastic.

This research is designed to explore associations between a broad range of musical abilities, language development and memory in 3- and 4-year-old children with the aims of a) examining these links more extensively and at a younger age than previously studied, b) identifying specific links between musical and linguistic abilities that might be stronger than others. Original age-appropriate musical tasks were designed for this experiment and well-established standardized measures are used to evaluate linguistic skills and memory. As a means to provide a more detailed picture of environmental and cognitive factors that might be related to language acquisition and development, a third aim is to explore links between musical and linguistic skills and the family's musical environment as reported by the parents.

This investigation contributes to the debate of whether or not language and music might rely on shared cognitive mechanisms and aims to provide insights on how educational practice could facilitate language development and/or prevent language learning difficulties at a young age.

Young children with language problems: their development on language, speech and cognition during multi- or monodisciplinary therapy

Marjolijn van Weerdenburg

Radboud University Nijmegen, Netherlands

The aim of this study was to investigate the language, speech and cognitive development of Dutch children between 2;0 and 4;0 years with language problems. One group (i.e., the Multi Group) (n = 106) received multidisciplinary therapy with a mean number of 13,5 hours per week. The other group (i.e., Mono Group) (n = 39) received monodisciplinary speech therapy during 2 to 4 times a week in the home environment or received early childhood education because of their language delay.

A large test battery of standardized tests, questionnaires and an observation instrument was administrated at the beginning of the six-month period of intervention (T1) and at the end of the intervention (T2). The children were assessed on nonverbal intelligence, language comprehension and production, and speech, and their language and speech abilities were also observed in a play-ground situation. Furthermore, parents filled in questionnaires about their child's strengths and difficulties and quality of life, and they reported on their own experiences while raising their child with language problems.

Results showed that the children in the Multi Group were more behind on speech and language measures than the children in the Mono Group. However, both groups showed progress during intervention and, on some of the standardized language tests, their progress was larger than was expected on the basis of the norm group of the tests. However, on most speech, language and cognitive measures, the backlog of the Multi Group at T1 was still present at T2. There was no correlation between the intensity of the intervention and the progress that was made. Furthermore, there was no correlation between the intensity of the parents' consultation and the progress of the children.

Finally, this study has produced a lot of advices concerning the do's and don'ts of this kind of research in clinical practice and they will be discussed.

Children's gestural behavior changes as a function of familiarization and vocabulary size

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Familiarity with a situation is assumed to lighten the cognitive load for event processing and to free resources for higher cognitive performance such as language (Farrar et al., 1993). In our longitudinal study with 16 caregiver-child dyads, we explored how the gestural behavior of 14 months-old infants changes as a function of the familiarization with objects. We observed the caregivers and their children in the 'decorated room', a semi-naturalistic setting taken from Liszkowski & Tomasello (2011), between infants' 14th and 16th months. In biweekly sessions, the caregivers and their children came to our laboratory, where they looked at and communicated about the objects. Half of the 14 items were presented at every session, the other half was exchanged each time. This way, familiarization with some objects was achieved. Following the assumption that familiarity with a situation lightens the cognitive load and frees resources for speech, we predicted that by 16 months of age, the children will (1) increase their pointing with speech or (2) their overall speech to familiar items. Contrary to our assumption, we found that the pointing behavior with words increased towards unfamiliar items. This effect was driven by the group of children whose vocabulary was more advanced (High Vocabulary Group) (assessed by a parental survey when children were 21 months old). For speech, we found that only in the High Vocabulary Group, the amount of words increased significantly. In summary, our data about pointing lightening the cognitive load is not conclusive. It reveals different cognitive processing for infants as a function of vocabulary knowledge. Our finding that children from High Vocabulary Group used pointing increasingly often towards the unfamiliar items can be interpreted as children's ability to demonstrate either readiness to learn and/or cognitive load that is expressed by gestural behavior.

Speech act development and joint attention in infants acquiring sign- and spoken- language: A longitudinal study of mother-infant interaction

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Our understanding of how languages are acquired is crucially informed by how they are used in interaction. Snow et al. (1996) showed an increase in the frequency of speech acts between the ages of 14 and 32 months, while longitudinal observation (N=2) by Bruner et al. (1982) suggest that even 8-month olds use requests. In order to use and appropriately respond to speech acts, such as requests, infants need to utilize joint attention skills to establish the meaning (e.g. referent) of the speech act. Work comparing a signing and a speaking child revealed that the signing child used gaze and pointing more frequently and for more diverse communicative functions (Morgenstern, 2014).

Our study explored the role of language modality (visual or auditory) in the development of (proto) speech acts by comparing two longitudinal data sets of free-play mother-child interaction: IPROSLA (sign) and First Steps (spoken). We analysed 10-minute segments of 3 infants from each dataset at 9, 12, and 18-months. The questions we aimed to answer were whether certain speech act categories universally emerge in a specific order, how these speech acts are expressed and to what extent this development is influenced by language modality.

The data was coded for the following proto-speech acts: give, take, summon, recruitment, offer, and question, as well as joint attentional behaviours such as eye contact and pointing.

While the speech acts appear in identical orders for both datasets, summons are more prevalent in the signing sample; moreover, signing but not speaking infants show a clear developmental trajectory of learning to respond appropriately to summons. In addition, eye-contact is more prevalent in the signing infants at all ages and, from 12 months onwards, signing children initiate eye-contact during communicative actions four times more frequently than the speaking children. This finding is consistent with previous work (Lieberman et al 2014) and extends it to younger ages.

Null-results in well-designed and theoretically sound experiments

Poster session 2

Thursday, June 11, 13.00

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Infants' sensitivity to close timing of communicative interaction

Elma Hilbrink

Max Planck Institute for Psycholinguistics, Netherlands

Turn-taking is a fundamental skill of human interaction and specifically important in communicative exchanges. To develop into competent communicators infants need to learn to take turns in communicative exchanges in a timely fashion. Turn-transition in adult conversation is remarkably precise: with a median close to zero (Stivers et al 2009). However, few studies have assessed turn-timing in infancy.

Our aim was to assess infants' comprehension of turn-timing. Previous work by Striano et al. (2006) has shown that 6-month olds are able to detect a delay of 1second in an ongoing interaction. However, adult turn-timing in conversation is much faster than 1s and a longitudinal study on infants' own timing in mother-infant interactions found that also infants are much faster in timing turns in vocal exchanges; median gap duration of 525ms at 5 months (Hilbrink et al, under review). Therefore we set out to replicate the findings by Striano et al. (1s delay) and to extend these by assessing shorter delays.

29 Six-month-olds were tested in the same set-up as in the Striano et al. study: Mother and infant were sat in separate rooms and interacted via screens. During the 4-minute interaction a 1 second delay was introduced. The order of the live and delayed segments was counterbalanced. Similar to the original study we predicted that infants would gaze less at their mother in the delayed compared to the live segment.

Videos were coded for infant and maternal gaze, vocalization and smiling. While levels of gaze at mother were comparable to the Striano et al. study, analyses utilizing linear mixed models revealed no effects except for a condition x order effect, indicating that infant gaze decreased in the second part regardless of condition, which could be due to fatigue. A follow-up pilot with a more extreme delay of 3s found that infants look away more during the delay but only when starting with the live segment, no differences are found when starting with the delay.

British English infants segment words only with exaggerated infant-directed speech stimuli

Tamar Keren-Portnoy[1], Caroline Floccia[2], Rory Depaolis[3], Marilyn Vihman[1], Claire Delle Luche[4], Samantha Durrant[5], Hester Duffy[6], Laurence White[2] and Jeremy Goslin[2]

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The word segmentation paradigm originally designed by Juszcyk and Aslin (1995) has been widely used to examine how infants from the age of 7.5 months can extract novel words from continuous speech. Here we report on a series of 11 studies conducted independently in two British laboratories, showing that British-English learning infants aged 8 to 11 months fail to show evidence of word segmentation when tested in this paradigm (see Table 1). We relate this finding to previous observations that British toddlers know and produce, on average, fewer words than their American counterparts, and propose explanations based on the different stress structure of British and American English, together with variations in infant-directed speech style, as well as on subtle differences between the methodologies used by different labs.

Table 1. Summary of the 11 experiments, which all resulted in non-significant differences between the trained and the untrained words

Exp#	Stimuli	Exp. type	#test trials	n	Mean Age	Lab
1	Trochees (2 speakers)	P-W	12	16	10	Plymouth
2	Trochees (2 speakers)	W-P	12	16	10	Plymouth
3	Trochees	P-W	12	15	10	Plymouth
4	Trochees (exaggerated IDS)	P-W	12	16	11	Plymouth
5	Trochees (IDS)	P-W	12	16	11	Plymouth
6	Trochees	W-P	16	24	8	York
7	Trochees	W-P	16	19	9	York
8	Trochees	W-P	16	24	10.5	York
9	Mono	W-P	16	24	8	York
10	Mono	W-P	16	16	9	York
11	Mono	W-P	16	16	10.5	York

Experiment type indicates the order of stimuli. P-W indicates that passages were presented in the familiarization phase and words were used in the test trials. W-P indicates the reverse.

Bilingual infants' ability of associating languages to voices

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Bilingual adults associate their languages with different interlocutors and they also use this information to predict the context-appropriate language (Molnar, Ibañez, & Carreiras, 2015). The onset of this ability during bilingual acquisition is unknown. Four-month-old bilingual infants are able to perceptually discriminate their inputs (Byers-Heinlein et al., 2010; Bosch & Sebastian-Galles, 1997; Molnar et al., 2014). Whether they are also able to functionally separate them (e.g., linking a language to an interlocutor context) is unclear. In the current study, using a behavioral looking paradigm, we tested whether 4- and 8-month-old Basque-Spanish bilingual infants (N=30) are able to link two different female voices to their two different languages. First, we familiarized the infants with an interlocutor speaking Basque, and another interlocutor speaking Spanish. Then, in the test phase, the language of the interlocutors was changed. In this way, the infants were presented with a match condition (the interlocutor spoke the same language as she did during the familiarization) and a mismatch condition (the interlocutor spoke a different language in the test phase and in the familiarization phase). We predicted that if infants learnt the association between languages and the voices during the familiarization, then the match and mismatch conditions during the test phase should produce significantly different looking times. However no such difference was observed. The possible implications of such findings and the possible methodological limitations of this testing paradigm will be discussed.

Keep looking: No robust anticipatory looking paradigms yet in infant speech sound learning

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Our aim was to develop a short but robust anticipatory looking paradigm that would test 6- to 12 month-old infants' ability to learn to associate speech sounds with spatial locations, and generalize these associations to novel speech sounds. We designed 2 eye-tracking tasks to minimize coding error. Stimuli were highly discriminable words "bon" and "deet". Task 1 was contingent on infants' looking behaviors. Trials started with presenting the target word several times. Words were assigned a "correct" location on the left or right side of the screen. If infants looked to the correct side of the screen while hearing the word they were immediately rewarded; otherwise, the reward appeared on the correct side after a delay. Analyses showed that infants (n= 77) did not look towards the correct side more than chance. In Task 2, trials contained 5 words, and could be same trials (e.g. all 5 words were "bon"), or different trials (e.g. last 3 words were "deet"). Words were paired with pictures and assigned a "correct" location on the screen. No picture appeared with the third word. Analyses show that infants (n=14) did not anticipate: when the 3rd word was presented, they did not look more towards the correct side. Thus, Task 1 and 2 show that infants have difficulty learning speech-spatial associations within a short period of time. Finally we used an eye-tracking version of the visual occluder task by Albareda-Castellot et al. (2011). However, we were unable to reproduce their findings that infants (n=61) could associate different words with the re-appearance of an object on the left or right side of the screen. These results highlight that while in theory infant anticipatory looking tasks appear a promising tool to test infant speech sound categorization, designing valid tasks proves difficult. Thus, these results are crucial for helping researchers to develop more robust infant speech perception tasks that require learning and generalization of multimodal information.

Brain responses to typical mispronunciations among toddlers

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In first language acquisition research, investigations on the semantics and lexicon of the child are often conducted by measuring brain activity at the surface of the scalp (EEG). Such EEG studies have shown different brain reactions to matching and mismatching pairs of pictures and words from 19-month-olds (Friedrich & Friederici, 2005). Similarly, results from 20-month-olds exposed to auditory stimuli only indicated different brain reactions to correct pronunciations and mispronunciations (Mills et al., 2004). However, these studies do not take the typical production patterns in that specific age into account.

In the present study, we measured brain reactions of 13 24-month-olds exposed to pairs of pictures and words in four different conditions: correctly pronounced words, two different kinds of mispronounced words, and novel words. The first type of mispronunciations (M1) consisted in minor mispronunciations consistent with typical production patterns in first language acquisition, e.g. 'ko' instead of 'sko' (shoe). The second type (M2) was characterized by phonological changes that are not expected at 24 months, e.g. 'fo' instead of 'sko' (shoe). The novel words consisted of phonotactically possible Swedish non-words.

A principal component analysis (PCA) decomposition of the EEG data showed two patterns of posterior negativity typical of lexical-semantic processing: one for novel words in comparison to the other conditions, and the other for novel and M2 word forms compared to M1 and correct word forms. These results indicate that M1 are processed similar as correct word forms, and that M2 and novel words are processed alike. However, while these patterns were visually salient in successive components, the results were not statistically significant. We suspect that the non-significant results were due to the small dataset. Nevertheless, this study contributes to the discussion on the relationship between perception and production in first language acquisition.

Segmentation of rhythmic speech by French and German infants

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Across languages, initial stress is marked by intensity or pitch, whereas final stress is marked by duration. To explain this universal, Hayes (1995) proposed an auditory principle, the Iambic/Trochaic law (ITL; Hayes, 1995). The ITL may affect early speech segmentation: 7-month-old Italian infants segment trochaic (strong-weak) words when syllables in an artificial language (AL) vary in pitch (Bion et al., 2011), and 6.5- and 9-month-old English-learning infants segment trochees when syllables vary in intensity, and 9-month-olds segment iambs (weak-strong), when they vary in duration (Hay & Saffran, 2012).

Recent studies show that the effects of the ITL are modulated by language experience. For example, French speakers make less use of rhythmic cues than German speakers in speech processing, which the authors attribute to the lack of word stress in French and its presence in German (Bhatara et al, 2013). Hence, we hypothesized that the lack or presence of lexical stress in the input would affect infants' use of rhythmic cues for segmentation.

Our study included 320 7- and 9-month-old French- and German-learning infants. The task followed Bion et al. (2011): in a between-subjects design, infants were familiarized with an AL, in which syllables alternated either in duration, intensity, pitch, or nothing. At test, they heard prosodically flat bisyllables that had been trochaic or iambic in the AL. Like Hay & Saffran's, our AL consisted of eight coarticulated syllables, while Bion et al. used six syllables divided by pauses. As in Bion et al., our AL's statistical structure was flat (syllable TPs = 1.0), while Hay & Saffran's was varied (TPs = 1.0 or 0.2-0.4).

The overall result was null. There was no effect of condition, age, or language, and no interaction. This null result is important because we tested a large number of infants, and the experiment itself was a near replication of both Hay & Saffran's and Bion et al.'s study with only slight stimulus modifications.

Early speech production

Poster session 3

Friday, June 12, 15.30

Pivot-schemas in German first language acquisition

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A few months after children have produced their first words, they begin to use more complex utterances. In this way they describe simple scenes such as a change in the motion of objects, their identification or designation. It turns out that some of these utterances follow a systematic pattern. They are often organized around specific words and have a functional asymmetry between the involved components: One word seems to structure the utterance, while the other one occupies a variable slot. Briane (1976) described these structures as pivot schemas. Within a usage-based approach (Tomasello 2003), it is assumed that the acquisition of these structures takes place independently of each other and is attached to lexical items. The pivot schemas play a central role because they are the link between the early holophrases and complex constructions.

In this paper, a qualitative study is presented which discusses the question of whether pivot schemas are part of the language development in German. The analysed data consist of a high-density developmental corpus of a 2;2 year old child (30 hours of recording; transcribed in CHAT format). In accordance with Briane (1976: 8f.) pivot schemas are understood as "positional productive patterns". To classify them as such a chi square goodness of fit test was used.

At this time, there are no known large empirical studies that focus on pivot schemas in German. The present study provides the first results, which indicate that pivot schemas are part of language development in German. The analyzed constructions are characterized by a high positional restriction of the pivot-words within the pattern and by an overarching semantic content.

Braine, Martin D. S. (1976): Children´s first word combinations. Monographs of the Society for Research in Child Development 41(1).

Tomasello, Michael (2003): Constructing a language. a usage-based theory of language acquisition. Cambridge et al.: Harvard University Press.

Conducting Automatic Vocalization Assessment (AVA™) with Finnish twin data

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The research on children's vocal development has a long tradition with diary studies and small sample recordings. Built on this grounding work, milestones for vocal development have been established and several kinds of checklists presented (e.g. Nathani et al., 2006). Currently there is a growing interest to study large samples and find ecologically valid tools for describing and measuring children's vocal development (e.g. Molemans et al., 2012).

For this purpose, an interesting tool has been presented: The LENA™ System is an algorithm-based computer software, which uses automatic speech recognition technology to identify, segment and analyze day-long recordings. One feature of the LENA System software is an automatic tool for vocal assessment (AVA™), which has currently been standardized for American-English (for detailed description see Richards et al., 2008).

In this preliminary study, we recorded and analyzed data with AVA from 20 twins acquiring Finnish. Children were recorded in family homes monthly from 6 to 12 months of corrected age (129 recordings in total). Appearance of vocal milestones was controlled with a standardized questionnaire (Lyytinen et al., 2000).

The results show, that twins in this study scored lower (M=89,1, Md=88,96, SD=12.63) on AVA compared to standards. 20% of all analyzed twin recordings scored below -1.5 SD, which in AVA is considered to be a possible marker for language delay. Results are discussed from methodological viewpoint and in the light of twin research.

Molemans, I., van den Berg, R., van Severen, L., & Gillis, S. (2012). How to measure the onset of babbling reliably? Journal of Child Language, 39(03), 523-552.

Lyytinen, P., Ahonen, T., Eklund, K. & Lyyitnen, H. (2000). Ääntelyn ja motoriikan kehityksen seurantamenetelmä. Jyväskylä: Niilo Mäki Institute.

Richards, J.A., Gilkerson, J., Paul, T. & Xu, D. (2008). The LENA™Automatic Vocalization Assessment. Lena Technical Repots LTR-08-01.

The effect of structural, frequency, and probabilistic characteristics on preschoolers' speech planning

Elina Rubertus[1], Aude Noiray[1] and Christine Mooshammer[2]

[1]*University of Potsdam, Germany;* [2]*Humboldt University of Berlin, Germany*

This study investigates effects of lexical and sublexical properties on the temporal organization of children's real word production. In adults, structural, frequency, and probabilistic characteristics of words have been shown to influence word production both at the planning (prior internal organization) and the articulation stage (actual production). Some properties were found to have a facilitative impact and others revealed inhibitory effects. While the role of these parameters has been investigated in children's word learning and comprehension, little is known about their effects on children's word production and its planning, as well as about how these may change with increasing language practice.

Focusing on speech planning, a simple versus delayed picture naming paradigm was employed to compare reaction times (RTs) of 6 German preschoolers aged 4 with those of an adult control group. The paradigm allows for a differentiation between lexical and postlexical effects, measuring RTs of both processes in the simple but only of postlexical processes in the delayed condition. Various factors were manipulated: Structure of the initial syllable (VC, CV, CCV), first segment (/k, t, ʃ, i, a, u/), phonotactic probability, neighborhood density, word frequency, and syllable frequency. The main goals were to test whether each factor shows inhibitory or facilitative effects on the production planning, and to temporally locate their impact within the process (i.e. lexical vs. postlexical).

Our first results indicate that children display longer RTs than adults in both conditions possibly due to limited language experience. As expected, RTs of both groups are longer in the simple than in the delayed naming condition probably because the task captures the time required for both lexical access and articulatory planning. Further analyses on how the amount of language practice affects the investigated parameters' influence on the RTs are currently being conducted.

A prosodic view of contrastive focus in child language acquisition

Laura Cristina Villalobos Pedroza

UNAM, Mexico

I submit a research in its first phase that aims for inquiring about intonational correlates of information structure on the early language acquisition of Spanish. The main objective is to explore whether the contrastive focus production has any prosodic correlate in child language. It has been claimed that one of child's strategies to create a common ground with her partner is to establish joint attention through shared perceptual salience in the physical context. Also, children are able to read the intentions of the interlocutor through mechanisms like the gaze, gestures and speech (Clark 2003). Some authors have purposed that infants begin to understand and use intonational focus as a means of joint attention around two years (MacWhinney & Bates 1978; Grassmann & Tomasello 2007; 2010).

Therefore, the intonation is a field where cues about child's intention to highlight any element in speech could be found. In particular, when a contrast focus appears, the speaker expresses his intention to direct listener's attention towards a particular element (e.g. DAD: they are turned on; CHIL: no, they are burned).

Because of this, we have selected the contrastive focus, compared with other types of focus cited in the literature (see Lambrecht 1994; Van Valin & La Polla 1997). It appears to be a safe area to search for prosodic correlates of infants' intent to direct the other's attention, and to establish joint attention.

The methodology of this work emphasizes natural interaction's importance, so it will be based on a girl's spontaneous speech (1;11-2;02) of the ETAL database (Rojas 2007). A selection of contrastive focus utterances (segmented with PHON (Rose & Hedlund 2014)) will be transcribed phonetically and acoustic measurements using Praat (Boersma & Weenink 2014) will be made. Additionally, I will make prosodic transcriptions in the notation system ToBI (Estebas & Prieto 2009; de la Mota et al. 2010). I will analyze acoustic and intonational patterns in the corpus.

Early vocabulary development in French monolingual children and activity types

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Quantitative and qualitative aspects of early lexicon development in young children are highly variable. This variability can be explained by individual and environmental characteristics, in particular social and linguistic ones (Fenson et al. 1994 ; Huttenlocher et al. 1991). In addition, previous research has described language development differences according to activity type (such as mealtimes: Snow & Beals 2006, book reading: Raikes& al 2006, or toy play: Newland & al2001).

In our study, we will focalize on less studied activity types and measure their influence on child and mothers linguistic productions. Our goal is to show that maintenance (health care, eating time) and social activities (social play, discussion) are favoring language use and language development in comparison to solitary play and environmental exploration. Children were video recorded longitudinally in interaction with their mothers from their first words until after their lexical spurt. For this study we analyzed 5 French children (2 girls, 3 boys) at 2 developmental steps: the beginning of words production and during lexical spurt.

First of all, children exhibited different developmental trajectories. Moreover, we observed differences in activity exposure between children with word tokens, types and lexical diversity varying with activity. In addition, children with the more tokens and types, are the ones with the greatest social activities exposure.

More children and more utterances per activities will be necessary to confirm these results. Indeed, all children didn't perform the same activities during recorded sessions which lead to different activity exposure time. However, these results are promising as they show that activity type can explain the variation observed in mother and child productions. Activities like social play and discourse due to more social interactions and more opportunities to speak seem to make language development easier.

Word onset clusters: linking children's perception and production

Clara Levelt[1] and Caroline Junge[2]

[1]Leiden University, Netherlands; [2]Utrecht University, Netherlands

All children initially reduce consonant clusters in word onsets to single consonants. In Dutch there are two types of word onset clusters: obstruent-sonorant clusters and /s/-obstruent clusters. Although children reduce both cluster types, the omission occurs in different positions: for obstruent-sonorant clusters, the sonorant is usually omitted, while for /s/-obstruent clusters, the /s/ is omitted. We therefore ask ourselves how their perception of word onset clusters works, and if the two types of clusters also behave differently in perception. One way to test whether children have stored words in detail is to compare their looking performance to target when words are correctly produced or mispronounced (Swingley & Aslin, 2000). Using such a mispronunciation paradigm, we carried out two perception studies in which mispronunciations of the two types of consonant-clusters were congruent or incongruent with child production data: clusters were either reduced to the typically surviving consonant (Experiment 1a) or reduced to the consonant that is typically omitted (Experiment 1b). Across experiments, we show that indeed the two cluster types lead to different results in perception: two-year-olds notice omissions, but only those concerning the /s/-obstruent clusters (3-way interaction of Naming x Correct/misproduced x Cluster-type: $F_{1,33} = 7.45$ p=.01; no interactions with Experiment-type). However, their production data reveal different trajectories: children generally produce the /s/-obstruent cluster later than the obstruent-sonorant cluster. Finally, we will link the perception data to the production data from the children who participated in the perception experiments, revealing that there are different subpopulations within a typical developing population. Together, this research provides evidence that differences in early child production stem from differences in lexical representations, suggesting that perception and production share representations.

Phonological characteristics of the lexicon at 2;0 years predict language outcomes a 3;6 years

Stephanie Stokes, Thomas Klee, Jayne Newbury and Catherine Moran

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Phonological characteristics of the lexicon at 2;0 years predict language outcomes a 3;6 years

Toddlers' first words are of higher mean phonological neighborhood density (ND) than words learned later. The words of children with delayed lexical development are of significantly higher mean ND than those of typically developing children. A relationship between a higher mean ND value at 2;0 years and expressive language skills at 3;6 years may indicate that early word processing difficulties inhibit ongoing development.

Parents of 143 children completed MCDI forms when the children were 2;0. PLS-4 tests were administered at 2;0 and 3;6 years. Child individual mean ND scores were generated from CDI monosyllabic nouns, verbs, adjectives and adverbs. Standard scores were generated for the PLS-Expressive (PLS-E)..

Regression 1: ND-Time 1 accounted for 35% of the variance in PLS-E Time 1 (β = -4.19, t = -8.61, p < .001), and Age was not a significant predictor (β = -.07, t = -1.05, p = .30).

Regression 2: MCDI-T1 scores accounted for 27.4% of unique variance (β = .03, t = 4.50, p <.001) in PLS-E Time 3, with Age-T3 and ND-T1 contributing 6.1% (β = -.201, t = -3.93, p = <.001) and 4.6% (β = - 1.38, t = -3.22, p = .002) of unique variance respectively.

ND at 2;0 was a significant predictor of PLS-4 scores at both 2;0 and 3;6 years, once Age and early MCDI scores had been accounted for, indicating some continuing effects of early lexical processing difficulties on continuing language development. Manipulating ND as an intervention variable may result in better outcomes for children at the low end of performance.

Early language comprehension and lexical development

Poster session 3

Friday, June 12, 15.30

Early comprehension of sound-symbolic words in Japanese infants

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Adult sensitivity to non-arbitrary sound-meaning relationships, i.e., sound symbolism, is universally robust across languages. However, it remains controversial whether infants are sensitive to sound symbolism. Previous studies suggest that English learners at 4 and 12 months show sensitivity to sound symbolism (Starr & Brannon, 2012; Ozturk, et al. 2013), but not French and Spanish learners at 4-5 months (Fort et al., 2013; Molnar & Martion, 2013). To address sound symbolism's robustness, the present study focused on Japanese learners to examine whether they can map sound-symbolic words onto meanings under more controlled conditions.

We tested Japanese-learning 9- and 12-month-olds using a modified version of an intermodal preferential-looking paradigm. In the training phase, infants were shown a pair of familiar pictures (e.g., dog and cat) side by side on a black background while hearing an isolated word that was congruent with the target picture ("Look! A doggy!"). Then, an attractive picture emerged as a reward at the position of the target picture. We predicted that this procedure would encourage the infants to look at the target during the congruent word's presentation. In the test phase, they were shown a pair of pictures with different textures (e.g., smooth or spiky) while hearing sound-symbolic words (e.g., "tsuru-tsuru" or "toge-toge") without any rewards. We measured the proportion of looks at both pictures.

Preliminary results with 20 infants showed that they looked significantly longer at the target than the distractor regardless of age in months, suggesting evidence for sound symbolism in Japanese infants at 9-12 months of age. A control experiment using conventional words (e.g., hei-katsu [smooth] or sen-ei [spiky]) is in progress to confirm the infants' looking behavior toward non- sound-symbolic words. Together, the data will be discussed in light of the robustness and properties of sound symbolism in the earliest stage of lexical development.

Incremental word processing in the second year of life

Angelika Becker[1], Ulrike Schild[2] and Claudia Friedrich[2]

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In the present study we use eye tracking to investigate incremental word processing in 18 – month-olds. In a previous study we showed that children aged from 6 up to 24 month use word onset syllables to predict upcoming words in spoken word onset priming (Becker et al, 2014). However, ERP signs of adult like lexical access in the first two years of life were missing, despite of diverging empirical evidence (Mani & Plunkett, 2011; Fernald et al., 2001). We tracked eye movements of the toddlers to test whether word onset priming in infants reflects access to word forms and their meaning, or whether word onset priming basically reflects phonological expectancy and matching mechanisms in infancy. Children heard spoken word onsets (e.g. first syllable of trousers) which were directly followed by visual displays of two objects (e.g. a pair of trousers and a scissor). One of the depicted objects was the primed target (the trousers); the other object was a distractor item (the scissor). Left-right presentation of targets was counterbalanced across the experiment. Children's eye movements showed a bias towards the target object. Thus, the prime syllable appears to pre-activate the target word in the children's lexicon up to a meaning level. This is evidence for incremental word processing in the second year of life.

Early distinction of the noun/verb categories

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Object-related referents and action-related referents are distinguished at the grammatical level: objects are usually denominated by nouns and action by verbs. Does infants make this conceptual distinction: upon learning a word do they distinguish between a more object-concept referent compare to a more action-concept referent?

To investigate this question, we used a Mismatch Negativity (MMN) paradigm known to be efficient for revealing abstract distinction in infants. Four CVCV words, either all nouns or all verbs preceded a test stimuli. This target word presented either a category change (Different condition) or not (Same condition). All words, precursors (set of 7 different nouns and 7 different verbs) and target (1 noun and 1 verb), were selected to be the most commonly known words by 10-month-old infants. This paradigm was first validated with Italian adults. The comparison of the Different/Same condition revealed a negativity in the 50-150ms window recorded by the centro-frontal electrodes (p=.0001) resembling to a MMN. Variance analysis of this effect with precursor (verb ~ noun) and Category of the test stimulus (verb ~ noun) revealed an interaction of Precursor x Category (p=0) and no effect of Category or Precursor. This result indicated that a noun presented after a verb sequence is processed differently than the same noun presented after a sequence of noun. (same is true with verb). We are currently testing Italian infants of 10 months, if they use different brain resources for processing object-referent and action-referent, we should observed as in adult a MMN. Preliminary results of the test of 10 month-old infants revealed a significant negative effect when comparing Different/Same condition over the central channels during the 300-450ms period p=0.04. If our pattern of results is confirmed in the next months, it will indicate that infants distinguish very early in life action-referent (verb) from object-referent (noun).

Semantic development in Iranian Persian-speaking children

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Introduction: Children start using word combinations when they are as young as 18 months old. This will allow them to convey variety of intentions in the form of different semantic relations including two- and three-word combinations with increasing grammatical complexity.

Since there is no sufficient data about semantic development of Iranian Persian-speaking children, the current study aimed to determine different types of semantic relations and lexical diversity of 40 to 54 months old Iranian children's language productions.

Method: Fifty four children randomly selected from day care centres and their language samples were audio-recorded during free play with their mothers. The samples were orthographically transcribed following Persian adapted conventions of SALT. The inter-rater reliability was checked for 20% of language samples.

Types of two- and three-word semantic relations were identified by comparing samples with Persian semantic structure. Number of different words(NDW) was used as a measure of lexical diversity and calculated using SALT software(2012,research edition).

Results: Children used 152 different words by average (SD=35.2). The most frequent two- and three-word combinations were agent-action and agent-object-action respectively. In contrast, action-object and object-action-locative were the least frequent relations with no occurrence.

Conclusion: Compared to English, Persian-speaking children are similarly diverse in producing words. Grammatically analysed, majority of Persian-speaking children's semantic relations follow Persian formal word order which is S-O-V. So, it can be concluded that semantic relations are language-specific and should be determined according to grammatical specifications of each language.

Considering the lack of current knowledge about normal semantic development of Persian-speaking children, this study contributes in establishing norms as well as developing assessment tools for evaluating children with language impairment.

Is a frog always an animal? The changing nature of developing semantic categories

Helen Buckler and Elizabeth Johnson

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Word recognition involves more than just understanding the canonical meaning of a word. Studies with adults (e.g. Huettig & Altmann, 2011), toddlers (e.g. Johnson et al., 2011) and young children (Huang & Snedeker, 2011) show that lexical activation occurs across a number of levels. For example, the word "frog" activates its semantic category "animal" and perceptual characteristics e.g. it is typically green. In online word recognition tasks 2-year-olds make use of both semantic and colour characteristics to direct their visual search. When asked to find the frog when no frog is present, they will look to an image that shares either semantic (another animal) or colour properties (anything green). In this study we aimed to investigate if this effect replicates with 3-year-olds (N=15), who have larger vocabularies and presumably more refined semantic categories. We successfully replicated the effect of color-association but not semantic-association at this age. Repeating the study with 24-month-olds (N=15) using identical stimuli elicited effects for both semantic and color association, ruling out the possibility that the null-result was an artifact of stimuli selection or experimental design. Instead this result provides potentially important insight into the developing nature of semantic categories. Similar studies with older children and adults tend to use thematic relations (lock-key) or subsets of categories (e.g. dolphin-whale), whereas our stimuli used superordinate categories of animal and food (e.g. frog-cat, strawberry-cookie). This result suggests that increasing vocabulary size leads to changes in the nature of semantic representations.

When children experience reduced exposure to the community accent: Are bananas still yellow?

Helen Buckler and Elizabeth Johnson

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Headturn Preference and Preferential looking studies suggest that by 1.5 to 2 years of age, children recognize words spoken in familiar and less familiar accents with equal ease (e.g., Van Heugten, 2012; Floccia et al, 2012). This is surprising given that adults experience some temporary processing delays when presented with an unfamiliar accent (Cristia et al., 2012). We investigate the possibility that in past studies, ceiling effects or lack of fine grained temporal analyses may have masked any potential processing delays toddlers may experience when processing words spoken in less familiar accents. We use a variant of the Visual World Paradigm that asks children to find absent-referent targets (e.g., they see a yellow cup and a blue cup and are asked to find the banana). Past studies with this paradigm have shown that children exposed to words spoken in their own accent will momentarily look to the color-matched distractor when the target is absent (e.g., when asked to look at the banana, they look at the yellow cup; e.g., Johnson et al., 2011). Note that in order to show this effect, children must access representations for known words in the absence of a visual prompt (i.e., they must recognize the word banana without being prompted with the picture of a banana). We predicted that children who were less familiar with the dominant community accent may show reduced or delayed looks to color-matched distractors.

Our prediction was supported. 34-month-olds more familiar with the community accent (N=15) looked to color-matched distractors significantly more than chance 500-1000ms post word-onset. Children exposed to multiple accents, therefore less familiar with the community accent (N=9) were slower to locate the color-matched distractor, doing so only in the third 500ms time bin (1000-1500ms post word-onset). Lexical activation is reliable for both groups of children, but variability in the input leads to fine temporal differences at 3 years old.

Japanese infants' use of functional morphemes in syntactic categorization of nouns and verbs: Frequently omitted noun particles versus obligatory verb suffixes

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Previous research has reported that both German- and French-learning infants come to use preceding function morphemes to syntactically categorize nouns earlier than they do so for verbs (Höhle et al, 2004; Shi & Melançon, 2010). These phenomena have been explained by referring to the fact that the co-occurrence relationship between content words and function morphemes (such as determiners and pronouns) is stronger for nouns than for verbs in these languages. In contrast, the co-occurrence relationship between a content word and its function morpheme is stronger for verbs than for nouns in Japanese, since particles attached to nouns are often omitted in colloquial Japanese speech whereas a verb never occurs without a verb suffix. Therefore, in Study 1, we examined whether Japanese-learning 15-month-olds (N=48) could syntactically categorize novel nouns and verbs by attending to following function morphemes, i.e., noun particles and verb suffixes. The results indicated that the infants succeeded in syntactically categorizing nouns by attending to following particles whereas they failed to use verb suffixes to syntactically categorize verbs. To identify the reason for this, in Study 2, we analyzed mothers' speech to their 15-month-old infants. The results demonstrated that besides the most frequent particle following 12 % of noun tokens in mothers' speech, there were four other frequent particles, each of which occurred with 4 to 7% of concrete noun tokens. In contrast, most of the verb tokens were followed by a verb suffix, i.e., -tteiru ('be X-ing'), and other verb suffixes were infrequent. In addition, infants almost always hear a particular verb with a particular verb suffix. This is because each verb was likely to be marked for a particular aspect. Influences of such distributions of function morphemes on children's learning of syntactic categories of nouns and verbs were discussed.

Predicting language outcomes from early comprehension: Contributions of age, vocabulary size, and trajectory

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The fact that children who develop persistent language delay are most likely to be delayed in both comprehension and production (Desmarais et al., 2008; Ellis & Thal, 2008) makes prediction from early comprehension to later language skills imperative. The present research asks whether receptive vocabulary assessment at 16 months can predict language outcomes at 30 months, and if these predictions are improved at 22 months. Results are discussed in terms of variability in individual vocabulary trajectories from 16 to 22 months.

Receptive vocabulary was assessed with the MCDI:WG (Fenson et al., 2005) and the CCT (Friend et al., 2012; a forced choice procedure in which children's haptic responses to lexical items are taken as evidence of word knowledge) in monolingual English infants (N=60) at 16 and 22 months. At 30 months, expressive vocabulary was assessed on the MCDI:WS and a 20-minute language sample. Analyses were performed using the Reduced CDI, which includes items on the MCDI in common with the CCT. Omnibus tests indicated that Sex, but no other control variables, contributed to prediction. Regressions were performed with Sex in Step 1, 16-month predictors in Step 2, and 22-month predictors in Step 3. CCT scores at 16 months were marginally predictive of language sample MLU but not NDW. The prediction to MLU reached significance at 22 months. In contrast, the Reduced CDI was predictive of later MLU at both ages.

We observed two unique trajectories for CCT scores from Wave 1 to Wave 2: about one-third of children had relatively flat trajectories (increased by an average of 5 words) whereas other children improved dramatically (increased by an average of 20 words). Regressions revealed that 16-month CCT scores significantly predict MLU at 30 months only for those children with relatively flat language trajectories over the second year. Thus, language growth is an important consideration for prediction in addition to age and absolute vocabulary size.

Which measures of toddlers's lexical development predict later lexical and grammatical competence? A longitudinal study

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Early lexical skills can be assessed in different ways. These include indirect measures such parental reports (e.g., the McArthur-Bates Communicative Development Inventory, MCDI, Fenson et al., 1993). Direct measures of lexical comprehension are also available in several languages (i.e. the Computerized Comprehension Task, CCT, Friend & Keplinger, 2003, a forced choice task in which the child touch the referent of a given word). Alternatively, dynamic measures such as fast-mapping tasks have been argued to provide valuable information regarding the child's facility in acquiring new word-object mappings. The aim of the current paper is to report a longitudinal study designed to test the predictive power of indirect, direct, and dynamic measures of lexical development at 16 and 22 months on language performance measured at age of 29 months in a sample of 65 monolingual French-speaking infants. In Wave 1 (16 months), the infants were tested with the MCDI;WG, the CCT, and a fast-mapping task based on Woodward et al. (1994). In Wave 2 (22 months), the toddlers were tested with the same assessment tools, except for the fact that the MCDI;WS replaced the MCDI;WG. At age 29 months, language was assessed using the MCDI;WS again, as well as two standardized tests tapping lexical and grammatical comprehension in French (Khomsi, 2001) and a spontaneous language sample recorded in a free play situation. Regression analyses were performed including the infants' gender and their mothers' education level in Step 1, the Wave 1 variables in Step 2 and the Wave 2 variables in Step 3. Results show that Gender and Mothers' education did not contribute significantly to Wave 3 language outcome. By contrast, most Wave 3 measures are significantly predicted by the MCDI receptive vocabulary at age 16 months, to which the CCT score at age 22 months adds a strong contribution. These results suggest that the contribution of indirect and direct measures differs as a function of the infants' age.

Sensitivity to Lexical Tone Variation in Spoken Word Recognition in Bilingual Toddlers

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There is a well-established literature on sensitivity to mispronunciations in infants and toddlers, primarily deriving from studies on consonant and vowel mispronunciations. Tone languages, which form the majority of languages around the world, are comparatively under-represented. Recent investigations on the phonological representation of tone in the developing lexicon have revealed important distinctions as compared with consonants and vowels (e.g. Singh, Tam, Chan & Golinkoff, 2014). The purpose of the current study was to investigate sensitivity to tone substitutions in spoken word recognition in bilingual toddlers, learning both Mandarin and English with varying degrees of exposure to Mandarin. Using the Preferential Looking Paradigm, 22 participants were exposed to correct pronunciations, a highly perceptible substitution (alternation between tones 1 and 4) and a highly confusable substitution (alternation between tones 2 and 3) of targets (familiar objects). Target words were presented in a side-by-side display with unknown distractor objects. Results demonstrated preferential fixation to targets when words were correctly pronounced and when they underwent a confusable substitution. When words underwent a highly perceptible substitution, participants preferentially fixated to the distractor object. Mispronunciation effects were not dependent on the amount of exposure to Mandarin and were robust across participants. Results suggest that the sensitivity to mispronunciations of lexical tone is dependent on the psychoacoustic properties of individual tones and that sensitivity to subtle tone variation is quite late to mature. The amount of exposure to Mandarin Chinese appears not to influence mispronunciation effects for tone in bilingual toddlers.

Infants' acquisition of grammatical gender co-occurrences

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To efficiently understand spoken language, children need to learn how words within sentences relate to one another. Once they realize, for instance, that articles are much more likely to be followed by nouns than by verbs (e.g., the ball, but not *the walked), this can help them constrain word candidates to specific lexical categories during online language processing. Although the ability to compute relationships between word classes is known to develop early in life (e.g. Höhle et al., 2004; Kedar et al., 2006; Shi & Melançon, 2010; Zangl & Fernald, 2007), little research has been conducted on infants' early sensitivity to subcategorical dependencies. Here, we use grammatical gender as a test case to examine children's reliance on subcategorical co-occurrences.

In gender-marking languages such as French, the form of the article is dependent on the gender of the associated noun (e.g. le-MASC doudou-MASC 'the security blanket', but la-FEM poussette-FEM 'the stroller'). While French toddlers exploit this information during linguistic processing by 25 months of age (Van Heugten & Shi, 2009), it is currently unclear when and how this skill is acquired. This study thus asks whether young infants track the subcategorical gender dependencies for words in their early mental lexicon.

To answer this question, 18-month-old French learners (N=24) were tested in the Central Fixation Procedure. They were presented with lists of familiar nouns, either preceded by the correct (e.g. la-FEM poussette-FEM) or by the incorrect definite article (e.g. le-MASC poussette-FEM). A clear listening preference for correct over incorrect co-occurrences was observed, suggesting that children's storage and access of words is sufficiently sophisticated to include the means to track subcategorical dependendies. This early sensitivity to these cues, whether grammatical or distributional in nature, may be greatly beneficial for anticipating upcoming lexical items during online language processing.

Learning Novel Words with Sound Effect in Japanese-learning 12-month-olds

Tessei Kobayashi[1] and Toshiki Murase[2]

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When infants begin to learn words over the first year of life, it is important to acquire knowledge about what constitutes an appropriate form for an object label. MacKinzie et al. (2011) found that English-learning 12-month-olds associated novel objects with novel CVC words ('fep'), but not with communicative sounds ('aaah') or consonant sounds ('shhh') in an associative learning task. To better understand the nature of an appropriate form for an object label, we focused on onomatopoetic words with sound effect such as 'bow-wow' (dog burking) and 'vroom' (car moving). In infant-directed speech in Japanese, onomatopoetic words are not only mimicking a sound, but also constituting an object label when the words are used with common intonation pattern. Therefore, it is intriguing to examine whether infants at 12 months respond differently to the onomatopoetic words with/without sound effect in an associative learning task. Thirty-two monolingual Japanese-learning 12-month-olds were habituated to two computer-animated scenes in which a novel object was paired with a novel onomatopoeia-like word ('ronron' or 'tenten'). While the infants in one condition (N=16) heard the words with sound effect (SE), those in the other condition (N=16) heard the words with common intonation pattern (CIP). After being habituated to the two scenes, they were given two same trials and two switch trials. Results showed that the 12-month-olds hearing the words with CIP looked significantly longer at the switch than at the same trials, indicating successful performance of word-object associations. In contrast, the 12-month-olds hearing the words with SE looked equally long at the same and the switch trials. A follow-up analysis found that they looked longer at the same and switch trials than the last 2 trials of the habituation phase. Together, these findings suggest that 12-month-olds respond differently to the onomatopoetic words with/without sound effect, although they can learn both words.

Gender variability of child word-comprehension and -production days

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Gender is a well-known factor in demography that affects infant development. A study using CDI database by Fenson (1994) reported that the effect of gender differences in infant development is very small. However, the variability in that study was evaluated in terms of acquisition of total vocabulary size. Therefore, in this study, we investigated the variability in infant vocabulary development in terms of word by word acquisition.

English, Spanish and Danish Lex2005 CDI database (Dale et al., 1996) and our Japanese CDI database (1,699 toddlers from 10 to 32 months) were used for this study. First, we defined the word comprehension and production days as the days when 50% of the children comprehend and produce the word, respectively. These days were determined by approximating the word comprehension and production rate curves by two logistic functions, setting the functions to 0.5 and solving them by the Newton method. Comprehension and production days were calculated for both male and female children, and their coefficients of correlations with gender were estimated.

The gender correlation coefficients in word-comprehension days for English, Danish, Spanish (in Mexico) and Japanese were 0.92, 0.96, 0.90 and 0.92, respectively. The corresponding correlation coefficients in word-production days were 0.96, 0.98, 0.92 and 0.94, respectively.

To investigate gender variability precisely, we selected male and female predominant words for each language, applying principal component analysis (PCA) to the word correlation distributions. The first and second components of PCA showed gender universality and dependent axis. Examples of male predominant production words were "fire track", "motorcycle" and examples of female predominant production words were "doll" and "dress".

The results of this study showed that word acquisition due to gender variability are small. In addition, small variability may be affected by children's preferences and lives.

Infant-directed speech

Poster session 3

Friday, June 12, 15.30

Pause and utterance duration in speech directed to 8- to 33-month-old children

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Child-directed speech differs from adult-directed speech in several ways. Prosodic, syntactic, lexical as well as temporal modifications are made by parents addressing their children. Parental speech input has been found to correlate with child language development from various perspectives focused on qualitative parameters. However, not only qualitative measures focused on content and structure but also simple quantitative measures of the linguistic input have shown to be of importance for child language development. The number of utterances and number of word tokens are found to correlate with early linguistic development (Hurtado, Marchman & Fernald 2008). Regarding temporal modifications, it has been shown that temporal contingency of mothers' responses, both linguistic and non-linguistic in nature, influence early language development (Goldstein, King & West 2003). Previous research has specifically shown that duration of pauses in parental speech correlates with early vocabulary size at 18 months (Marklund et al, 2014). This is a follow-up study focusing on duration of pauses and utterances in parental speech that compares parental pause and utterance duration in conversations with Swedish speaking children in a developmental perspective. The purpose is to describe durational aspects of parental speech in vocal interaction with three children from ages 8 to 33 months. It is expected that duration of parental pauses in response to child utterances is shorter at older ages.

Using Musical Cues to boost speech segmentation in 2 days-old neonates

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In order to build their lexicon, infants have to pick up the words that are embedded in a continuous stream of syllables. Because speech segmentation is one of the first steps of language acquisition, understanding how this cognitive process unfolds in early infancy is important for better defining the origin of later cognitive and linguistic deficits often observed in children born pre-term or in children with language learning deficits. However, little is known whether newborns have this skill already present at birth. Interestingly, there is evidence showing that prosodic cues such as pitch variations facilitate the segmentation process. Here, we present results of Event-related Potentials derived from electro-encephalographic activity recorded in 20 2 days-old sleeping neonates while they were presented with both flat contour and musically enriched streams of artificial syllables. We found brain signatures of successful segmentation for musically enriched but not for flat contour streams. These results provide neural evidence of the benefit of prosody in the first steps of language acquisition.

It's touch-and-say: Caregivers' multimodal behavior highlights body part words

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By 6 months, infants know some body part words, looking longer at a video of a hand than one of feet when hearing the word hand, and vice versa for the word feet (Tincoff & Jusczyk, 2012). Might caregivers use touch to guide infants to this knowledge? We explore this possibility through an artificial language experiment and two corpora studies.

First, we created an artificial language with no cues to word boundaries (as in Curtin, Mintz & Christiansen, 2005). Two groups of 4-month-olds heard this audio stream. For the baby-touch group, one trisyllabic sequence always co-occurred with the experimenter touching a given part of the infant's body. For the experimenter-touch group, consistent touches were to the experimenter's body, but were visually perceived by infants. At test, only the baby-touch group showed a significant preference between the touch word and a foil. Thus, infants can use touch cues to word segmentation.

To assess whether parents do produce touch-speech co-occurrences that are consistently aligned, we collected 2 corpora. In one, 12 mothers were asked to teach 2 body part words and 1 object word using the trisyllabic items used above. In the other, 24 mothers were asked to read to their child books, some of which contained body part words. In both corpora, caregivers tended to touch their infants more when the targets were body part words than non-body parts. These touches tended to be semantically congruent (i.e., touches to the elbow while saying "elbow"), and for such congruent touches the onset of the touch was closely aligned in time with the onset of the word, and the offset of the touch with the offset of the word (~.5 s).

Overall, these results are consistent with the view that caregivers' multimodal behavior highlights both the meaning and the form of body part words, and that infants' integrate touch when processing speech. Further research is needed to ensure that these findings generalize to body part word learning in the real world.

Variation sets in child-directed speech

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We use repetitiousness, one of the properties of Child-Directed Speech (CDS), as a window into the kind of constructions that parents try to convey to children. Below is an example from our data:

vill du sitta på den istället | ja den kan du sitta på istället om du vill

One way of formalizing repetitiousness is the notion of variation sets. We define variation sets as sequences of utterances with the same communicative intent in varying form (cf. Kuntay & Slobin, Psychology of Language and Communication, 6:5-14, 2002). We include verbatim repetitions since there is vocal (e.g., modulations in pitch, changes in timing and stress) and non-vocal variation (e.g., gestures).

Variation sets function as a device for effective communication with young children: the speaker repeats the same content to maximize the chance of comprehension. With increasing language comprehension, there is less need for such repetitions.

We present results from a corpus study on variation sets in Swedish CDS. The multimodally annotated corpus consist of 18 dyads with 3 children (age 0;7—2;7) and their caregivers (Björkenstam & Wirén, Multimodal Corpora, 2014). For this study, the corpus has been manually annotated with variation sets (inter-annotator agreement 78%).

We have grouped the dyads based on child age, resulting in four data sets: 1) 7—9 months, 2) 12—14 months, 3) 16—19 months, 4) 27—33 months. The proportion of utterances in variation sets decrease over time: about 50% for group 1, but less than 15% for group 4. The proportion of exact repetitions of the preceding utterance in variation sets also decrease: 24% for group 1, and 10% in group 4.

To the best of our knowledge, this is the first multimodal corpus annotated with variation sets, and the first corpus study of variation sets in Swedish CDS.

Articulation rate in infant directed speech

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Previous studies have shown infant directed speech (IDS) to be different as compared to adult directed speech (ADS), for instance in the sense that IDS contains

longer pauses, has a slower speech rate and contains fewer words per utterance than ADS (see e.g. Clark (2009) for an overview). However, there are to the best of my knowledge, no studies in which the articulation rate (the number of linguistic units per time unit with pauses excluded) has been compared between Swedish IDS and Swedish ADS. In this study, I address this issue.

The data consists of one subset from each of two corpora of transcribed spontaneous ADS and IDS, respectively: Spontal (Edlund et al., 2010), and Mingle from Long-Mingle (Nilsson Björkenstam and Wirén, 2014). I approximated the articulation rate to the number of vowels per second in the transcribed material. For each subset and for every adult speaker in that subset, I calculated the average articulation rate of all of his or her utterances. The articulation rate between the two corpora differs significantly (two-tailed unpaired t-test, p = 0.0006), with the Mingle corpus having a higher rate.

In future research, I aim to investigate to what extent the articulation rate varies within and between utterances, speakers and infant age groups in IDS.

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Infant-, robot-, peer-, and adult-directed speech by 3-, 5-, and 7-year-old children

Morgwn Paris and Denis Burnham

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Previous studies have shown that when young 2- to 4-year-old children speak to infants they accommodate their speech by reducing utterance length and sentence complexity, and using simpler verb tenses. However, there has been little investigation of the acoustic, phonetic, and affective aspects of children's Infant Directed Speech (InfantDS), nor of comparisons of InfantDS with other special speech registers that children may employ with particular audiences.

We investigated the speech of 3- (n = 6), 5- (n = 8), and 7-year-old (n = 8) children to an infant, (InfantDS), an animate robot (RobotDS), an age-matched peer (PeerDS), and to an adult (AdultDS), and took measures of Pitch Range, rated Positive Affect, and Vowel Triangle Area. For Pitch: children's InfantDS had higher pitch range than RobotDS, PeerDS and AdultDS, and there were no differences between these latter three. In addition, pitch range increased monotonically across age, irrespective of speech register.

For Positive Affect: there was greater positive affect in InfantDS than in the other three registers, and no difference between affect expressed to robots, peers, or adults. The results for Vowel Triangle Area were somewhat different: across all three child ages, InfantDS and RobotDS showed equivalent vowel triangle areas and areas for InfantDS and RobotDS were significantly greater than for PeerDS and AdultDS, between which there was no significant difference.

These results show that children as young as 3 years speak in a distinctly different way in InfantDS than in other speech registers in terms of pitch, affect, and vowel triangles. Moreover, with respect to vowels, both InfantDS and RobotDS show heightened triangle areas, suggesting that children perceive both infants and robots to require or invite didactic input, indicating some fledging theory of mind. On the other hand, at least with respect to the three variables measured here, children talk to their peers and adults in a similar fashion.

Turkish and French mothers' questioning behaviours to their children

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Caregiver perceptions and practices are highly influential on children's development (Bornstein, 2002; 2006). A salient component of parenting is responsiveness. From very early days, parents give a prompt, reliable and appropriate response to their babies' verbal and non-verbal actions, which is a good signal to babies, implying that they can be sure about their parents' immediate presence around them (Bornstein, 2002). Bornstein (2002) define maternal responsiveness as a set of prompt, contingent and suitable responses that parents exhibit to their children during daily life interactions. As it has been at the heart of developmental science, various components of maternal responsiveness have been investigated for several years (Tamis-LeMonda & Bornstein, 2002; De Wolff & van IJzendoorn, 1997). One of the keystones of maternal responsiveness is questioning. Przetacznik -Gierowska & Ligeza (1990) consider that parent-child questioning interactions fulfil an important role in the development of children's socio-communicative skills. In line with this background, this study analyses Turkish and French mothers' questioning behaviours in relation to the use of form and function in two different contexts: book-reading and toy-play. The data were composed of 20 Turkish and French speaking mothers and their children's 10-minute-video-recordings in identical settings. All spontaneous questions asked by the mothers to their children were extracted from the data. Similar to Rowland et al. (2003), we categorized wh-questions in three main groups as wh-pronominals (who, what, where), wh-sententials (how, when, why), and wh-adjectivals (which, whose). However; different from Rowland et al. (2003), we identified yes-no questions, incomplete questions, tag questions and questions through intonation as well. The results highlighted crosscontextual effects as well crosscultural effects between Turkish and French.

Fronting of vowels in infant directed speech

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An established finding in IDS research is the stretching of the vowel space in IDS compared to ADS. Findings for Norwegian indicate a shift in the IDS vowel space, corresponding to a more front articulation. The aim of the current study was to investigate whether the characteristics of formant frequencies found in Norwegian IDS extends to being a general effect or is restricted to only some vowel qualities. As previous studies of Norwegian IDS mainly report results for point vowels, the question remains whether this is a general effect in IDS. This motivated the investigation of the large number of Norwegian vowels. The corpus of data was collected using a natural setting for recording IDS and ADS. The vowel space for the first three formant frequencies for the twelve vowels /æ:-æ, ø:-ø, å:-å, y:-y, ʉ:-ʉ, e:-e/ were anticipated to be shifted in IDS compared to ADS, corresponding to a more front articulation. Acoustical and statistical analyses show that most of the vowel qualities studied were fronted, the /y:-y/ and /æ:-æ/ being exceptions. Results are discussed and interpreted to suggest fronting as a general effect in IDS, with a focus on whether these results mean the caregiver is trying to make speech visually salient to the infant.

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