

Project title: Development of emotion recognition in relation to linguistic development
Project duration: 4 years, 1,0 fte
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1. Topic and scientific relevance

Emotion recognition and understanding of spoken language are important components of social competence, both having their origins early in life. While the development of these abilities has been investigated mostly separately, not much is known about their interdependence.

Infants are highly sensitive to vocal and facial expressions of emotion. At the age of 5 months, they can detect vocal changes of affect (1) while 7-month-olds show different ERP responses to emotional versus neutral speech (2). Young infants already integrate vocal and facial cues when *recognizing* affect: 3.5 month-olds look longer toward faces that are accompanied by voices matching in affect (3). Recognition of affect using unimodal cues (face, voice) emerges at 5 and 7 months of age, respectively (4). Parents convey affection to their infants not only by bodily and facial gestures, but also by their speech. Infant-directed speech (IDS) is characterized by exaggerated prosody (pitch), reflecting free vocal expression of emotion to infants, aimed at attracting their attention and supporting social-communicative development (5-8).

During the period in which emotion recognition develops, infants are also starting to understand spoken language, in particular word knowledge, for which they need to learn the relations between sounds and referential meaning. Infants adapt their speech perception to the sound contrasts of their native language during the second half of their first year of life (9-11). Between 6-9 months, infants start learning sound forms of frequent words (12-13). True word learning only starts when infants begin to understand other humans as intentional agents, which is promoted by joint attention in parent-child interactions (14-15). An acceleration in the rate of word learning occurs late in the second year (16).

Fairly little is known about the developmental relation between emotion recognition and understanding of spoken language in infancy. Correlations between poor emotion recognition and delays in language acquisition were found for 4-9-year-old children (17-18), suggesting the relevance of the interplay of linguistic and emotional competence earlier in development. While it is known that positive affect in IDS attracts infants' attention, facilitating social-communicative development, it has been difficult to prove specific facilitative effects on language development. On the one hand, it was hypothesized that IDS supports linguistic development, for example, word learning due to prosodic enhancement of novel words (19-21). On the other hand, exaggerated prosody in IDS may obscure contrastive sound features relevant for word learning (22-24). Recognizing words across different emotional states is difficult for 7.5 month-olds (25). Positive affect may even reduce infants' cognitive attention and learning (26-27). For infants, the referential function of speech is concealed by an overlay of non-referential information, due to positive vocal affect – their task is to separate affective and referential content.

In sum, although the early developmental trajectories of emotion recognition and language acquisition have been investigated individually, not much is known about their interactions. It remains unknown how affect in parental input influences language acquisition, in particular how parental interaction style considering vocal and facial cues assists infants in separating affective and referential content in speech.

The current project investigates the relation between infants' affective development (recognition of vocal and facial emotion) and linguistic development (in particular, vocabulary growth and language processing ability), as moderated by parent-child interaction (PCI). Parental interaction style will be analyzed regarding coordinated use of voice, face, gaze and gestures ('multimodal motherese'; 28), containing a complex of overlapping cues for emotion and referentiality.

We aim at answering the following questions:

Q1: How does parental interaction styles influence infants' recognition of facial affect?

Q2: How does parental interaction styles influence infants' language development?

Q3: How do infants' differential responses to facial and vocal affect predict language development?

As to Q1, we hypothesize that infants' recognition of facial affect is facilitated by parental styles that strongly align facial and vocal affective cues. Hence, a positive correlation is expected between parental styles which redundantly cue facial/vocal affect and infants' recognition of facial affect.

Regarding Q2, the hypothesis is that parental styles in which affect is redundantly cued by matching vocal and facial means facilitate language development most, since redundant specification of vocal and facial affect facilitates infants' to disaggregate vocal cues for affect and referential meaning. Hence, a positive correlation is expected between multimodal redundant parental interaction styles and infants' language development.

Finally, for Q3 it is hypothesized that language development is positively influenced by infants' ability to differentiate multimodal cues for affect and referential meaning, as indicated by infant's looking and pointing behavior in response to parental input. Hence, a positive correlation is expected between differential responses to vocal cues for affect and referential meaning, and language development.

2. Methodological approach

Cohort

We will use data from infants at 5 months old that are collected as part of YOUth, an ongoing longitudinal cohort study. As the study progresses, we will use longitudinal data from the same children at age 10 months, and around 3 years old. Possibly, if time permits, around 6 years.

Brain imaging

The emotion recognition EEG paradigm consists of (a) at 5 months: blocks of faces expressing neutral emotions alternating with pictures of houses; (b) from 10 months onward: blocks of faces expressing different emotions alternating with pictures of houses ('Face house task').

Eye tracking

To assess language processing abilities, data from the 'looking-while-listening task' (29) will be used around 3 years.

Behavior and environment

Parental interaction style and infants' responses to parental facial/vocal affect will be assessed in audio-visual recordings of spontaneous parent child interactions (PCI) (N=100), with four camera positions, microphone. Additional PCI data will be collected (N=20) using a story telling task (21).

Questionnaire

Language development will be tracked by the MacArthur Communicative Development Inventories, adapted for Dutch (N-CDI; 30). This is a standardized parent report instrument capturing information about children's developing language abilities, including vocabulary comprehension, production, and grammar.

Analysis

Analysis focuses on parents' and infants' facial/bodily gestures (affective, referential), as well as oral communication (affective, referential). For the parent, we analyze (1) vocal and facial affect, and their temporal alignment; (2) vocal and bodily referential cues and their temporal alignment. Measures (1-2) will be combined into a general measure of parental multimodal affective/referential interaction style. For infants, we analyze (3) responses to multimodal affective and referential cues, resulting in a general measure of ability to differentiate affective and referential cues. Audiovisual transcription and coding is done partly by hand using protocols (28; 31); partly automatized, aligning vocal-facial cues.

3. Innovative capacity

Little is known about the influence of emotion recognition on early language acquisition. This is the first study of how infants' integration of multimodal cues to vocal/facial affect assists early language acquisition.

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