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# Is response to infant-directed speech an early marker of Autism Spectrum Disorders?

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# Introduction

- ▶ Very young children have biases that orient their attention to relevant signals in their environment.
- ▶ **Typically developing infants are fascinated by socially relevant stimuli** (Butterfield & Siperstein, 1970; Valenza et al., 1996; Vouloumanos & Werker, 2007), **especially by the speech addressed to them - the so-called infant-directed speech (IDS)** (Cooper & Aslin, 1990; Dunst et al., 2012; Fernald, 1985; McRoberts et al., 2009; Schachner & Hannon, 2011; Werker, Pegg, & Mcleod, 1994).
- ▶ IDS effectively orients and holds infants' attention, and engages infants' language learning through social interaction (Cristia, 2013; Floccia et al., 2016; Kubicek et al. 2014; Kuhl, 2007; Weisleder & Fernald 2013).





# Introduction



- **Infant-directed speech (IDS) is a linguistic stimulus that is socially relevant.**
- Compared to adult-directed speech:
  - Sentences tend to be shorter and often grammatically more simplified (Newport, Gleitman, and Gleitman, 1977);
  - The set of prosodic contours is less variable (Fernald and Simon, 1984);
  - Frequently, focused words are placed at the end of sentences and marked with exaggerated pitch peaks (Fernald and Mazzie, 1991);
  - Higher pitch, larger pitch range, slower tempo, and enhanced rhythmic features tend to be used (Fernald, 1992); for a recent review, see Cristia, 2013.



# Introduction



► **Infant-directed speech may serve to:**

(1) obtain and/or maintain attention (Fernald, 1992),

(2) to communicate affective and contextual information (Fernald, 1992), and

(3) to enhance language learning (Morgan and Demuth, 1996; Song, Demuth, and Morgan, 2010; Kuhl, 2007) in a number of different domains such as:

(3.1) word segmentation (e.g., Thiessen, Hill, and Saffran, 2005; Floccia, Keren-Portnoy, DePaolis et al., 2016),

(3.2) word learning (e.g., Saffran, Aslin, and Newport, 1996; Weisleder and Fernald, 2013), and

(3.3) audio–visual associative learning (Kaplan, Bachorowski, Smoski, and Hudenko, 2002; Kaplan, Jung, Ryther, and Zarlengo-Strouse, 1996; Kubicek, Gervain, Hillairet de Boisferon et al., 2016).

# Introduction

- By contrast, individuals with autism have known deficits in the realm of social communication, and there is reason to hypothesize that the typical preference for socially relevant stimuli is altered in this population.



Restricted,  
repetitive patterns  
of behavior,  
interests, or activities



Deficits in social  
communication  
and social  
interaction

**Autism Spectrum Disorders** (APA, 2013)

# Introduction



- ▶ As early identification, diagnosis, and intervention provide better long-term outcomes, **early markers of Autism Spectrum Disorders (ASD) have gained increased research attention.**
- ▶ Along the lines of the ongoing project **EBELa | Eyes and Brain: Early markers on Language development**, in progress at the Lisbon Baby Lab.



- ▶ Our goal is to better **understand the atypical biases in speech processing that may cue the atypical social-communicative development in ASD**, and explore potential implications for early identification and early intervention.



# Introduction



- ▶ In particular, we aim **to review evidence related to auditory processing enhanced by social interest, specifically the processing of infant-directed speech in infants at high-risk for ASD** (i.e., younger siblings of children with ASD, as around 20% of these children have been found to meet the criteria for ASD by their 3<sup>rd</sup> year of life; Ozonoff et al., 2011).



# Method

- This review was conducted using PsycINFO database with the keywords: '**Autism**' and '**Auditory Processing**' in conjunction with '**Infant-Directed Speech**', '**Child-Directed Speech**', '**Motherese**', and/or '**Maternal Speech**'.
- Based upon title and abstract screening, a total of **41 references** were identified through the search process and were selected for full text review.
- The final sample of articles was divided into three categories:
  - General auditory processing in ASD,
  - Auditory processing of IDS in ASD, and
  - Auditory processing of IDS in infants at high-risk for ASD.





# General Auditory Processing in ASD

- Research shows that individuals with ASD are often more skilled than typically developing peers at low-level processing of auditory stimuli (i.e., pitch).

(Bonnell, Mottron, Peretz et al., 2003; Bonnell, McAdams, Smith et al., 2010; Heaton, Hudry, Ludlow, and Hill, 2008; Heaton, Williams, Cummins et al., 2008; Jones, Happe, Baird et al., 2009; O'Riordan and Passetti, 2006).

- By contrast, they often reveal impaired performance in tasks with more complex auditory stimuli such as speech, and/or in more difficult tasks involving processing of auditory stimuli.

(Dawson, Meltzoff, Osterling et al., 1998; Dawson, Toth, Abbott et al., 2004; Fujikawa-Brooks, Isenberg, Osann et al., 2010; Gervais, Belin, Boddart et al., 2004; Källstrand, Olsson, Nehlstedt et al., 2010; Kuhl, Tsao, and Liu, 2005; Lepistö, Kuitunen, Sussman et al., 2009; Teder-Salejarvi, Pierce, Courchesne et al., 2005; Whitehouse and Bishop, 2008).

A decorative graphic on the left side of the slide. It features a dark blue vertical bar on the far left. A black arrow points to the right from the top of this bar. Below the arrow, several thin, curved lines in shades of blue and grey sweep across the page towards the right.

# General Auditory Processing in ASD

- ▶ Possibly, more accurate pitch perception together with impairments in complex auditory processing can be explained by reduced preference to linguistic/social information.
- ▶ In fact, more specific deficits have been found for social stimuli versus non-social stimuli (Dawson, Meltzoff, Osterling et al., 1998; Dawson, Toth, Abbott et al., 2004; Kuhl, Coffey-Corina, Padden et al., 2005; O'Connor, 2012, for a review).



# Auditory Processing of Infant-Directed Speech in ASD

- ▶ Some studies also have found that individuals with ASD have an atypical preference for sounds; in particular, they do not show the expected preferences for IDS stimuli over other auditory stimuli (e.g., Kuhl, Tsao, and Liu, 2005; Paul, Chawarska, Fowler et al., 2007).
- ▶ Potentially, examining IDS processing patterns among infants and young children may be useful as a marker of risk for ASD and may also predict later language outcomes.



# Auditory Processing of Infant-Directed Speech in Infants at High-Risk for ASD

- ▶ As around 20% of siblings of children with ASD meet criteria for this disorder by their third year of age (Ozonoff, Young, Carter et al., 2011), prospective studies of infant siblings have frequently been used as a methodological approach to studying early markers of ASD.
- ▶ These studies follow younger siblings of children with ASD from early infancy until 2-3 years of age (when the diagnosis can be achieved). They allow the comparison between different developmental trajectories of infants who later do or do not meet ASD diagnostic criteria.



# Auditory Processing of Infant-Directed Speech in Infants at High-Risk for ASD

- ▶ **Droucker, Curtin, and Vouloumanos (2013)**

- ▶ Comparing high-risk infants to low-risk infants at 6, 8, 12, and 18 months they found that the low-risk siblings showed a trend to look longer at IDS than adult-directed speech at 8 months that was not apparent at this age in the high-risk siblings.
- ▶ The low-risk group also showed higher expressive language scores (assessed by the MacArthur Communicative Development Inventories spoken vocabulary checklist; CDI) at 18 months than the high-risk group, and this result correlated with preferences for IDS at 12 months.



# Auditory Processing of Infant-Directed Speech in Infants at High-Risk for ASD

- ▶ **Curtin and Vouloumanos (2013):**

- ▶ They addressed the question of whether atypical preferences for speech at 12 months are associated with ASD symptoms at 18 months.
- ▶ At 12 months, high-risk infants were compared to low-risk infants on their preference for speech stimuli versus complex non-speech analogs of the speech stimuli.
- ▶ The high-risk group did not listen reliably longer to speech and this group's atypical preference for speech was associated with autistic behaviors at 18 months.



# Discussion and Conclusion

- Indeed, research shows that individuals with ASD are often more skilled than typically developing peers at low-level processing auditory stimuli.
- On the other hand, they often reveal impaired performance in tasks with more complex auditory stimuli such as speech, and/or in more difficult tasks involving processing of auditory stimuli.
- Studies also have found that individuals with ASD have atypical sound preferences: in particular, they do not show the expected preferences for IDS stimuli over other auditory stimuli.



# Discussion and Conclusion

- ▶ Collectively, the findings from studies of infant siblings of children with ASD suggest that the atypical preferences related to IDS stimuli seen among children with ASD may arise in **early development**. Moreover, this difference may underlie deficits in later language development and social communication.
- ▶ This review provides evidence for IDS processing as a potential early marker of ASD. However, the explanation for differences in IDS processing among children with ASD versus other children is still unclear, as are the implications of these impairments for later social-communicative development.



# Related Projects

## ► Research Project

EXCL/MHC-LIN/0688/2012 - Sónia Frota (PI)

*Early markers of language development (EBELa)*



## ► Postdoctoral Project

SFRH/BPD/100696/2014 – Marisa Filipe

*Early Markers of Autism: Infant-Directed Speech and Social-Communicative Functioning*



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