Atypical processing of prosodic changes in natural speech stimuli in school-age children with Asperger syndrome

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• Neurodevelopmental disorders characterized by:
  • deficient social and communication skills
  • repetitive patterns of behavior
• Main diagnostic groups: Childhood autism and Asperger syndrome (AS)
  • Individuals with AS have normal development of formal speech and normal verbal intelligence
  • 75% individuals diagnosed with childhood autism are also diagnosed with intellectual disability
Language abnormalities in AS

- Impaired semantics and pragmatics
- Problems with “reading the mind in the voice”: Rutherford et al. (2002)
- Abnormal prosody common feature:
  - monotonic speech
  - pitch / volume control deficits
  - deficits in vocal quality
  - inappropriate use of stress

"Laugh one’s head off"
Autism research with EEG

Electroencephalography (EEG) = measuring the electrical activity of the brain from the surface of the scalp

- Non-invasive
- High temporal resolution
- Event-related potentials (ERPs) reflect neural activity related to sensory or cognitive events
- Recordings can be done even in absence of participants’ attention and task performance
Atypical processing of prosodic changes
Mismatch negativity MMN)

- Reflects automatic, pre-conscious detection of violations of auditory regularities
- Elicited by any discriminable change in auditory flow
- Can be elicited in the absence of the participants attention
- Large MMN amplitude = accurate auditory discrimination
  Small MMN amplitude = poor discrimination accuracy
- Used with many clinical groups (e.g. coma, dyslexia, autism)
- Reflects further attentive discrimination of stimulus deviation
- Diminished P3a amplitude: abnormal attention switch
- Enhanced P3a amplitude: distractibility

Here will be a picture of MMN and P3a
Abnormal cortical speech-sound processing in children with AS

- Impaired low level speech-sound feature encoding (Jansson-Verkasalo et al., 2003; Lepistö et al., 2006; Kujala et al., 2010)
- Impaired duration, vowel and consonant change detection (Jansson-Verkasalo et al., 2003; Lepistö et al. 2006; Kujala et al. 2010)
- Impaired pitch discrimination in Kujala et al. (2010) but hypersensitive pitch change detection in Lepistö et al. (2006)
- Hypersensitive reactions to the intensity changes (Kujala et al., 2010)
- Less efficient auditory stream segregation ability (Lepistö et al., 2009)
Processing of prosodic changes in natural speech in children with AS

- **Subjects:** 10 healthy children and 13 children with AS (mean age 10 years). Data collection continues.
- **Measurements:** non-attentive ERP recordings (children were watching a silent movie) and behavioural discrimination test.
- **Stimuli:** a Finnish word “Saara” uttered by a female speaker with four different emotional connotations. The stimuli were previously used by Kujala et al. (2005) and developed by Leinonen et al. (1997).
Behavioural paradigm

50% of pairs

50% of pairs

16.6% of pairs

16.6% of pairs

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Standard

Deviants

Task: press the response button according to whether the sounds are the same (two standards) or different (a standard followed by any of the deviants).
EEG paradigm

Each deviant stimulus preceded by at least two standards

Standard 79%

Neutral [Saara] 577 ms

Deviants 7% each

Commanding [Saara] 538 ms
Sad [Saara] 775 ms
Scornful [Saara] 828 ms

Constant SOA

0 1300 ms
No significant group differences were found for the hit rates or reaction times.

However, the majority of children with AS tended to show prolonged reaction times for the deviant stimuli.
Grand average difference waves

Scornful
Fz
-6μV
-100 ms
6μV
Cz
Pz

Sad
Fz
-6μV
1000 ms
Cz
Positive deflection
Pz

Commanding
Fz
Cz
Pz

Children with AS
Control children
Preliminary ERP results

- Children with AS showed atypically large MMN amplitudes for the sad prosodic deviant, indicating hyperactive neural responsiveness for prosodic changes
- No group differences were found for the amplitude of the positive deflection
- Korpilahti et al. (2007) showed enhanced MMNs to commanding prosodic change
- Kujala et al. (2005) showed diminished MMN amplitudes to the same prosodic changes in adults with AS.
- In future studies our aim is to further explore, which specific prosodic features are processed atypically in children with AS
References
