Auditory processing in autistic individuals

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None declared.

Following the diagnosis of auditory processing disorder (APD) and a cochlear lesion in an eight year old boy with Asperger's syndrome]which is now included in the autism spectrum disorder (ASD)] and severe hyperacusis but normal pure tone audiometry, the question of auditory processing in ASD has arisen. This article provides information on recent research data that have not yet been widely taken into account in the clinical practice.

DSM classification of autistic spectrum disorder and atypical auditory processing

In the Diagnostic and Statistical Manual of Mental Disorder, fifth edition (DSM-V) [1] there is no mentioning of auditory processing disorder in autism spectrum disorder. Hearing is barely acknowledged when describing onset of symptoms in children suspected of ASD during the first years of life. The manual presents the possibility that a hearing loss may be suspected as a result of delayed language development but it is typically ruled out. However, evidence exists that:

1. Auditory related symptoms are most frequently documented during the diagnostic process of autistic spectrum disorder
2. Atypical auditory processing is present in individuals with autistic spectrum disorder at both behavioural and neural levels
3. Auditory processing deficits are more likely to occur when processing complex stimuli.

1. Auditory related symptoms are most frequently documented during the diagnostic process of autistic spectrum disorder

The International Molecular Genetic Study of Autism Consortium analysed a UK Autism database and found that diagnostic and phenotypic data in 486 children diagnosed with ASD showed that 65.8% were hyper-sensitive to noise and 89.3% had some type of sensory related symptom. Alcantara et al (2004) [2] further analysed 248 UK cases from the same database, revealing that when all available information is explored, a sensory deficit was present in 96.8% of the cases diagnosed with ASD. *Difficulty perceiving speech in noise situations and negative reactions to background signals occurred in more than 75% of the Autistic children.* These results are in accordance with another study of patterns of sensory abnormalities in children and adults with ASD [3,4] showing sensory symptoms and abnormalities in multiple domains. In spite of these data, diagnostic criteria for ASD do not include any sensory symptoms even in the newly released DSM-5.

2. Atypical auditory processing is present in individuals with autistic spectrum disorder in both behavioral and neural levels

Research extends from pitch perception to prosody identification and speech in noise perception in children and adults. There is evidence of enhanced pitch perception in children diagnosed with ASD. Adolescents and adults with ASD perform better in pitch perception than normal controls only in a subgroup were language-related difficulties are prominent. Why enhanced pitch perception and language impairment co-exist is not clear. Two possible explanations have been suggested. One of them is that superior pitch perception is the result of reduced linguistic attention during development. This is consistent with the preference exhibited by individuals with ASD to attend to music and non-speech stimuli over speech. The second possible explanation regards enhanced pitch perception as the cause of impaired language development. The rationale of this suggestion is that increased awareness of pitch changes may be the cause of hypersensitivity and consequent stimulus overload, resulting in impairment of linguistic information processing.

Hyperacusis is frequently present in autistic individuals concerning loud sounds and noise, or focusing on certain sounds by perceiving them as louder than others.

Hyperacusis in ASD should be evaluated by an ENT-Audiologist.

Sounds eliciting hyperacusis in ASD include unexpected ones (e.g. barking of a dog), combinations of multiple sounds (e.g. occurring in noisy shopping malls) and high-pitched continuous sounds (e.g. a vacuum cleaner). This enhanced loudness sensitivity appears to be declining with age and coexists with typical performance on intensity discrimination tasks.

Atypical orientation to sound is documented in ASD children when compared with typical developing children. Specifically, ASD children are less likely to orient their attention to speech as opposed to other sounds and to their mother's voice as opposed to multi-talker babble. Reduced orientation to speech sounds is often present.

Concerning prosody, research has vastly focused on production rather than perception. Specifically standardised analysis provides evidence of exaggerated or 'robotic' intonation, abnormal use of stress and inappropriate accent. ASD individuals with these prosody production symptoms are more likely to have problems with social interaction. Receptive prosody evidence includes impaired and / or atypical processing of affective prosodic cues, which is more prominent when complex vocal expressions are present.

3. Auditory processing deficits are more likely to occur when processing complex stimuli

ASD individuals frequently present difficulties perceiving speech in the presence of background noise or babble. The ability to understand speech in noise / babble depends on acoustic cues discrimination of a target speaker focusing on pitch, location and timing and is facilitated by top-down processes such as attention, short-term memory and language skills. Extracting speech from other auditory stimuli is accomplished when a person takes advantage of spectral and temporal 'dips' in competing noise. Temporal dips prevail when there is a decrement of the intensity level of existing noise or babble, whereas spectral dips are dependent on dissimilarity of target and competing stimuli. Both higher signal to noise ratios and cognitive skills facilitate speech in noise perception.

In spite of the fact that speech in noise difficulties are frequently reported in individuals with ASD, limited research concerning auditory processing abilities of ASD individuals in background noise or babble is available. Research data shows that children and adults with ASD show reduced utilisation of temporal dips when compared with control groups. Adults with ASD are less accurate in localising non-speech sounds in the presence of competing distracter signals, which may be attributed to enhanced difficulties filtering out irrelevant auditory stimuli. Indication exists that reduced frequency selectivity at the level of the cochlea may worsen the ability to differentiate a target stimulus from competing sounds.

Overall, atypical auditory processing in individuals with ASD is shown as being evident not only at the behavioural level, which is mostly discussed in this article, but also at neuroimaging and neurophysiological levels. Definite explanation of this atypical auditory processing in ASD is still lacking. Future research is needed to provide more concrete evidence of how atypical auditory processing relates to the clinical profile of ASD but the clinician should be aware of the possibility of cochlear lesions that should be diagnosed, and of auditory processing disorder that may be remediated through auditory training. Hyperacusis in ASD should be evaluated by an ENT-Audiologist.

References

1. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders: DSM-V*. Washington, DC, American Psychiatric Association; 2013.
2. Alcántara JI, Weisblatt EJL, Moore BCJ, Bolton PF. Speech-in-noise perception in high-functioning individuals with autism or asperger's syndrome. *Journal of Child Psychology and Psychiatry and Allied Disciplines* 2004;**45(6)**:1107-14.
3. Leekam SR, Libby SJ, Wing L, Gould J, Taylor C. The diagnostic interview for social and communication disorders: Algorithms for ICD-10 childhood autism and Wing and Gould autistic spectrum. *Journal of Child Psychiatry and Psychology* 2002;**43**:327–42.
4. Leekam SR, Nieto C, Libby SJ, Wing L, Gould J. Describing the sensory abnormalities of children and adults with autism. *Journal of Autism and Developmental Disorders* 2007;**37**:894–910.