# Does Autism Affect Auditory Processing?

By Nina Kraus, PhD, and Travis White-Schwoch



According to the Centers for Disease Control and Prevention, approximately one in 54 children has been identified as having autism spectrum disorder (ASD), compared with one out of 150 only 20 years ago (http://bit.ly/2Gb9nY5). ASD defies generalization, but it can affect a constellation of social, communication, and behavior domains. Audiological evaluation is part of a comprehensive developmental assessment for ASD because it is important to rule out hearing loss as an explanation of children's communication difficulties. There is, however, growing evidence that autism may affect auditory processing, including how well the brain processes the subtleties of spoken language—even in children with ASD but who have clinically normal hearing.

Russo and colleagues compared 21 children ages 7-13 years with ASD diagnoses but relatively high levels of language skills to 18 age-matched controls (*Dev Sci*. 2009;12:4). The children with ASD had slower and smaller neural responses to the speech sound "da," suggesting a potential liability in auditory processing. The children with ASD also exhibited greater degradation of their neural responses to speech in background noise. Interestingly, higher receptive language skills tracked with less degradation in noise, suggesting a link between children's auditory processing and language challenges.

The same authors followed up on this work in a paper specifically investigating the neural processing of pitch (*Clin Neurophysiol*. 2008;119:8). Having demonstrated a general liability for processing sound—and a potential link to the communication difficulties often found in children with ASD—they hypothesized that neural processing of speech might contribute to children's social communication acumen. They compared the same children on neural responses to the sound "ya," spoken with either a rising pitch prosody (as in a question) or a falling pitch (as in a declaration). Overall, children with ASD had poorer tracking of these pitch cues than controls. Analyzing individual responses showed that 16 of the 21 children with ASD showed this pattern of disrupted neural tracking of prosody, consistent with the diversity of the ASD population. The same children also had less stable responses to both "da" and "ya," further indicating that neural processing of speech could be a bottleneck in children with ASD (*Exp Brain Res*. 2018;236:3).

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What about younger children? Jones and colleagues pursued this question in an ambitious study of toddlers with ASD (*J Speech Lang Hear Res*. 2020;63). They compared children ages 2-3 years with an ASD diagnosis to age-matched controls. Due to the practical challenges of measuring neural responses to speech in toddlers, this study only used the "da" stimulus. They attempted to measure neural responses in 40 toddlers with ASD and successfully collected them in 18 of the children, whom they compared to 18 matched controls. Neural responses were largely similar between the ASD and control groups. Moreover, they found no reliable correlations between neural function and behavioral measures of early language skills.

These results indicate an intriguing nuance: toddlers with ASD have similar neural responses to speech as their peers, but school-aged children with ASD have weaker responses. There are several possible explanations for this discrepancy:

- Selection. One notable result from Jones and colleagues is that they could only reliably measure neural responses to speech in 45 percent of the children with ASD they initially enrolled. Because behavioral challenges can be part of the ASD phenotype—especially in toddlers—this may have inadvertently selected a certain subset of ASD children, such as those with relatively normal auditory processing skills. However, the children with ASD who were successfully tested performed similarly to those who were not on several standardized behavioral scales and measures.
- Heterogeneity. A hallmark of ASD is the heterogeneity of the population. With a higher prevalence in the population, one could imagine that ASD cohorts in research are only getting more diverse. Russo and colleagues collected their data when the prevalence of ASD diagnoses was much lower in the population, meaning they could have recruited

a more homogeneous group of children with ASD. Additionally, due to time constraints, the toddlers were not tested on the "ya" stimuli by Jones et al., which could reveal deficits in prosodic processing in this younger cohort.

- Auditory processing: Cause or effect? The auditory processing differences identified by Russo and colleagues may *result from* the social-communication difficulties in ASD rather than *directly causing* them. The hearing brain receives input from many non-auditory regions, including those dedicated to social-emotional rewards and connections. Growing up with dampened connections between hearing and these social systems may cause abnormal development of auditory processing, which might only emerge over time.

These explanations are not mutually exclusive and can only be resolved definitively through a longitudinal study of children with ASD. Overall, current evidence indicates that school-aged children with ASD are at heightened risk for auditory processing problems. When exactly these problems emerge—and in what subsets of the ASD population—remain exciting avenues for future research.