

The Use of Listening Devices to Ameliorate Auditory Deficit in Children with Autism

Gary Rance, BEd, DipAud, MSc, PhD¹, Kerryn Saunders, MBBS(Hons), RACP², Peter Carew, BSc, MAud¹,
Marlin Johansson, BSc, MAud³, and Johanna Tan, BSc, MAud¹

Objectives To evaluate both monaural and binaural processing skills in a group of children with autism spectrum disorder (ASD) and to determine the degree to which personal frequency modulation (radio transmission) (FM) listening systems could ameliorate their listening difficulties.

Study design Auditory temporal processing (amplitude modulation detection), spatial listening (integration of binaural difference cues), and functional hearing (speech perception in background noise) were evaluated in 20 children with ASD. Ten of these subsequently underwent a 6-week device trial in which they wore the FM system for up to 7 hours per day.

Results Auditory temporal processing and spatial listening ability were poorer in subjects with ASD than in matched controls (temporal: $P = .014$ [95% CI -6.4 to -0.8 dB], spatial: $P = .003$ [1.0 to 4.4 dB]), and performance on both of these basic processing measures was correlated with speech perception ability (temporal: $r = -0.44$, $P = .022$; spatial: $r = -0.50$, $P = .015$). The provision of FM listening systems resulted in improved discrimination of speech in noise ($P < .001$ [11.6% to 21.7%]). Furthermore, both participant and teacher questionnaire data revealed device-related benefits across a range of evaluation categories including Effect of Background Noise ($P = .036$ [-60.7% to -2.8%]) and Ease of Communication ($P = .019$ [-40.1% to -5.0%]). Eight of the 10 participants who undertook the 6-week device trial remained consistent FM users at study completion.

Conclusions Sustained use of FM listening devices can enhance speech perception in noise, aid social interaction, and improve educational outcomes in children with ASD. (*J Pediatr* 2014;164:352-7).

Atypical responses to sensory stimuli across a number of modalities including the visual, tactile, and auditory are frequently reported and are now a mandatory component of autism spectrum disorder (ASD) diagnosis as specified in the *Diagnostic and Statistical Manual of Mental Disorders–Version 5*.¹ Aberrant reactions to auditory stimuli were noted in Kanner's original article on autism² and recent evidence has suggested that a high proportion of affected children suffer auditory processing deficits that particularly disrupt the ability to hear and understand speech in the presence of background noise.³⁻⁵ Identification and appropriate management of hearing problems in this population are especially important as auditory deficits can, in themselves, restrict social and communication development.⁶

There are 2 main approaches to reducing functional hearing deficit in children with listening-in-noise (figure/ground) problems. The first is to improve the quality of the signal reaching the child's ear, and the second is to train him/her to make the best use of that signal. In the case of the latter, results of training programs for children with ASD have not been reported, but there is a growing amount of literature suggesting that figure/ground deficit may be ameliorated through targeted auditory habilitation.⁷⁻⁹

Optimization of the listening environment (particularly in the school setting) is important and can be achieved through structural modifications (fitting of ceiling tiles, carpets, etc) and sound field (loudspeaker) amplification of the teacher's voice.¹⁰ Another option is the use of personal frequency modulation (radio transmission) (FM) listening systems. These devices transmit speech signals (detected by a lapel microphone worn by the speaker/teacher) via radio waves to ear-level receivers worn by the child. As such, they improve the signal-to-noise ratio as the speech is louder, relative to the background noise at the child's ear. FM devices have been used effectively to minimize listening problems for children with cochlear hearing loss,¹¹ central auditory processing deficit,¹² and auditory neuropathy.¹³ Furthermore, a recent pilot investigation by Schafer et al¹⁴ has shown listening benefits for ASD children wearing FM systems for short periods in "structured" educational situations. The sustained use of these devices in mainstream classroom environments has, however, has not yet been explored in children with ASD.

APHAB	Abbreviated Profile of Hearing Aid Benefit
ASD	Autism spectrum disorder
FM	Frequency modulation (radio transmission)

From the ¹Department of Audiology and Speech Pathology, The University of Melbourne; ²School of Medicine, Nursing and Health Sciences, Monash University, Melbourne, Australia; and ³Department of Audiology, School of Medicine, Lund University, Lund, Sweden

Funded by the Jack Brockhoff Foundation, the Collier Foundation, and the Deafness Foundation. PHONAK.org donated the FM devices. The authors declare no conflicts of interest.

0022-3476/\$ - see front matter. Copyright © 2014 Mosby Inc. All rights reserved. <http://dx.doi.org/10.1016/j.jpeds.2013.09.041>

Table. Characteristics of the study participants with ASD

Subject	Sex	Age at assessment, y	Average hearing level, dBHL	CARS	Other ASD evaluations	WISC-IV (FSIQ)
ASD1	Male	15.4	13.75	31	-	106
ASD2	Male	15.2	10.00	39	-	104
ASD3	Male	15.1	5.00	35	-	94
ASD4	Male	14.8	8.75	34	-	92
ASD5	Male	14.2	3.75	36	-	94
ASD6	Male	13.5	5.00	36	-	86
ASD7	Female	13.4	13.75	30	-	91
ASD8	Male	13.0	10.00	33	-	83
ASD9	Male	12.6	13.75	35.5	-	71
ASD10	Male	12.5	8.75	37.5	-	-
ASD11	Male	12.0	6.25	-	BASC II/ADOS	95
ASD12	Male	11.7	10.00	32	-	89
ASD13	Female	11.6	15.00	36	-	72
ASD14	Male	11.4	8.75	35.5	-	84
ASD15	Male	11.2	9.25	27	-	99
ASD16	Male	10.0	10.00	-	BASC III/ASSQ/CBCL	89
ASD17	Male	9.1	6.25	33.5	-	-
ASD18	Male	9.1	11.25	36.5	-	-
ASD19	Male	9.0	6.25	31	-	106
ASD20	Female	8.0	3.75	<30	CBCL/ADI-R	-

Average hearing level, 4-frequency average hearing level based on sound detection obtained to pure tones at 500-, 1000-, and 4000-Hz test frequencies; HL, hearing level; CARS, Childhood Autism Rating Scale; WISC-IV (FSIQ), Wechsler Intelligence Scale for Children IV (Full-Scale IQ); BASC II/III, Behavioral Assessment System for Children II/III; ADOS, Autism Diagnostic Observation Schedule; ASSQ, Autism Spectrum Screening Questionnaire; CBCL, Child Behavior Checklist; ADI-R, Autism Diagnostic Interview-Revised.

We conducted the present study to explore the hypothesis that provision of FM listening devices would enhance speech perception in noise, aid communication, and improve educational outcomes for children with ASD.

Methods

Twenty children with ASD participated. The disorder was confirmed in each case via a multidisciplinary clinical assessment using a range of instruments including the Autism Diagnostic Interview^{15,16} and Childhood Autism Rating Scale¹⁷ (Table). Only children with no known coexisting disabilities and Full-Scale IQ, Wechsler Intelligence Scale for Children¹⁸ values >70 were referred for the study. Sound detection ability was normal in each case. All participants could speak and understand/follow verbal instructions and all attended their local (mainstream) school. None of the children were receiving academic in-class support at the time of the study.

Participant age at assessment ranged from 8.0 to 15.4 years with a mean $\pm$ SD of 12.0 ± 2.3 years. The 10 younger children (ASD11-20) were enrolled in primary-school settings, and the 10 older participants (ASD1-10) were secondary-school students.

A cohort of age- and sex-matched control participants was also evaluated. Age at data collection was within 12 months of the ASD partner, and each control was screened to ensure normal cognitive profile and to confirm that they were not on the autism spectrum (Childhood Autism Rating Scale score <20).

The research protocol was approved by the Ethics Committee of the Royal Victorian Eye and Ear Hospital, and written informed consent was obtained for each participant. Each subject began by completing (alone or with parental assistance) a hearing disability questionnaire—the Abbreviated

Profile of Hearing Aid Benefit (APHAB). This metric explores 4 aspects of auditory function: communication difficulty, effect of background noise, effect of reverberation, and aversiveness to sound. Participants then underwent a battery of auditory assessments designed to evaluate aspects of basic auditory processing and functional hearing.

Auditory temporal processing ability was established psychophysically using the techniques described by Alcántara et al.⁴ Thresholds for detection of sinusoidal amplitude modulation in a broadband noise were established for a range of modulation rates and plotted as a temporal modulation transfer function.¹⁹ Overall, sensitivity to modulation was established by calculating a y -intercept value (reflecting the height of the function), and the temporal constant (τ) was derived from -3 -dB knee point in the function.

Binaural processing, the ability to effectively combine inputs from the left and right ears, was evaluated using the Listening in Spatialized Noise test.²⁰ This test measured the listener's capacity to use subtle interaural difference cues to improve sentence perception in background noise.²¹

Open-set speech perception ability was evaluated using the Consonant-Nucleus-Consonant-Word test.²² Testing was carried out in the free field with the subject seated between 2 loudspeakers. The front speaker presented a series of monosyllabic words calibrated to reach the child at 65 dB sound pressure level, while a rear speaker provided noise (4-talker babble) at the same level. The subject imitated the stimulus words, and a percentage of discriminated phonemes (speech sounds) was calculated by the examiner. Following this "unaided" assessment, the child was fitted with a Phonak Inspiro FM transmitter paired with iSense receivers (Phonak Org, Murten, Switzerland). The FM receivers are small devices that sit behind each pinna and are held in place by a soft, vented rubber earpiece inserted into the ear canal. Once the

Download English Version:

<https://daneshyari.com/en/article/6221916>

Download Persian Version:

<https://daneshyari.com/article/6221916>

[Daneshyari.com](https://daneshyari.com)