



## Original Article

## Investigating the Auditory Differentiation Skill in Normal 7-8 Year Old Persian Children in Shiraz

Afsaneh Doosti<sup>1, 2\*</sup>, Fatemeh Nourmohammadi<sup>3</sup>, Maryam Delphi<sup>4</sup>

<sup>1</sup>Department of Audiology, School of Rehabilitation Sciences, Shiraz University of Medical Sciences, Shiraz, Iran

<sup>2</sup>Rehabilitation Sciences Research Center, Shiraz University of Medical Sciences, Shiraz, Iran

<sup>3</sup>Department of Speech Therapy, School of Rehabilitation Sciences, Shiraz University of Medical Sciences, Shiraz, Iran

<sup>4</sup>Musculoskeletal Rehabilitation Research Center, Audiology Department, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

### ARTICLE INFO

#### Article History:

Received: 08/01/2018

Revised: 17/02/2018

Accepted: 17/03/2018

#### Keywords:

Auditory differentiation  
Central auditory processing  
Rehabilitation  
Auditory perception

### ABSTRACT

**Background:** Development of auditory differentiation skill plays an imperative role in the development of speech and language skills of children as well as central auditory processing. One of the instruments employed in the investigation of this skill is auditory differentiation test. The present study was conducted with the aim of investigating the auditory differentiation skill in normal 7-8 year old children.

**Methods:** The present cross-sectional descriptive study was performed on 200 normal girls and boys within the age bracket of 7-8 years with equal numbers of genders (100 girls and 100 boys). In order to examine the auditory differentiation skill, the Persian version of Wepman auditory differentiation test was employed. The significance level in this research was considered as  $P=0.05$ .

**Results:** The auditory differentiation score according to percentiles of 5 and 95 was 38 and 40 among the seven year old group, respectively, while it was 38.05 and 40 in the eight year old group, respectively. The mean auditory differentiation score of the seven year old children was significantly lower than that of the eight year old children ( $P=0.04$ ). No significant difference was observed between the two genders ( $P=0.19$ ).

**Conclusion:** According to the results obtained in this research, the auditory differentiation score was significantly different between the seven and eight year old groups, but no significant difference was observed between boys and girls.

2017© The Authors. Published by JRSR. All rights reserved.

### Introduction

As with other mechanisms, auditory mechanism has a complex system in which the auditory information reaches the ears from different auditory sources simultaneously [1, 2]. In other words, everybody experiences a complex auditory environment from their infancy, whereby the acoustic information resulting from active sources overlap simultaneously [2]. Accordingly, the person needs to differentiate between this information to perceive

and then respond to the environment for survival and communication. Infants should acquire the capacity to differentiate between speech sounds; otherwise, they will not be able to initiate language acquisition process [3]. Auditory differentiation is the ability to distinguish verbal sounds [4]. In other words, it involves the ability of the person to detect the similarities or differences between sounds of words [5].

Auditory differentiation is one of the central auditory processing skills or auditory perception that plays an imperative role in acquisition and articulation of verbal sounds [5]. Auditory neurons can be adjusted in such a way that the differences between sounds are maximized in the brain, thereby facilitating the differentiation of sounds

\*Corresponding author: Afsaneh Doosti, School of Rehabilitation Sciences, Abiverdi 1 Street, Chamran Boulevard, Shiraz, Iran.

Tel: +98 71 36271551

E-mail: [afsanehdoosti@yahoo.com](mailto:afsanehdoosti@yahoo.com)

[6]. It seems that defect in auditory differentiation is one of the causes of central auditory processing disorder [1]. Some children affected by this disorder have challenge receiving verbal sounds [7].

The relationship between auditory differentiation skill and disorders of articulation, speech and reading has been investigated. One of the researches suggested considerable challenge in the differentiation of verbal sounds in children with severe articulation disorder compared to those with weak articulation disorder [8-10]. Furthermore, another study suggested lower auditory differentiation skills in people with more severe phonological disorders compared to those with milder phonological disorders [6]. On the other hand, reading and writing are associated with the abilities of auditory processing such as auditory differentiation. In other words, the challenges associated with reading and writing during school age are to some extent related to the disorder of auditory differentiation development in the first months of life [9]. Enhancement of auditory differentiation skill in children suffering from dyslexia is one of the core objectives of rehabilitation by practitioners [11].

Inability to differentiate verbal sounds is observed in children with attention deficit hyperactivity disorder (ADHD) [12], Asperger's syndrome [10], children with normal peripheral hearing who had been exposed to pre-birth and during birth risk factors, as well as high-risk populations [13].

Consequently, it seems that performance of auditory differentiation test for patients suffering from central processing disorder, articulation disorder, phonological disorder, dyslexia, ADHD, Asperger's syndrome, premature infants and at risk infants employing speech language pathologist is essential, and it is a suitable parameter that can help with diagnosis of the disorder. On the other hand, this skill test has been conducted on four to six year Old Persian children in Semnan [14]; however, the normal score for the age group of seven and eight years has not been determined; thus, determination of the relevant scores in these age groups seems imperative.

The aim of this study was to assess and determine different percentiles of the auditory differentiation score of 7-8 year Old Persian children in Shiraz. The results obtained from this study can be used for screening during diagnosis of auditory differentiation defects in children.

## Methods

The present research is a cross-sectional study, which was performed with a statistical population of 200 normal Persian children within the age bracket of 7-8 years (equal numbers of girls and boys) in Shiraz. This study was approved at Shiraz University of Medical Sciences with the ethics code of IR.SUMS.REC.1394.194.

The schools were chosen randomly from all the primary schools in the four districts of Shiraz using cluster sampling technique. Thereafter, the children with normal auditory and speech system (lack of neurological

lesions for articulation) as confirmed by an audiologist and speech therapist, as well as children with normal intelligence quotient (according to the healthcare files) and those that are monolingual (Persian speaking) were included in this study after receiving informed ethical consent from their parents.

During the research, participants who were not willing to cooperate and continue with the research study were excluded from the study. The auditory differentiation test employed in this research was prepared based on Wepman test design for Persian language [15]. This test evaluates auditory differentiation of four to eight year old children [8].

The test consists of 40 word pairs (30 different word pairs and 10 identical word pairs). The different word pairs are the minimal pairs, i.e. they are composed of two meaningful words, which are different in only one sound such as bat and cat.

The words used in this test are monosyllabic. The identical words were scattered across all the words. The sum of the scores of this test was 40, i.e. per each correct response; one score was given to the child.

Initially, the procedure for the test as well as identical and different concepts was explained to the children using different words, which were not included in the test. After ensuring that the procedure was well understood by the children, the test was conducted. To this end, every child was made to enter a quiet room individually. Afterwards, the person conducting the test covered the mouth of each child and the child was requested to say whether the two words they heard were identical or not. If the response was correct, the score would be +1, otherwise it would be zero (0). Finally, the sum of the scores of each child was computed and considered as their auditory differentiation score.

For data analysis in this research, SPSS software, version (16) was employed. In addition to descriptive statistics, Kolmogorov-Smirnov test was first used to determine the normality of the sample volume. Thereafter, t-test was employed to compare the groups (seven and eight years old as well as male and female). The significance level was considered as  $P=0.05$ .

## Results

In the present study, 200 children between the age bracket of seven and eight years (100 boys and 100 girls) were studied. Each age group had 100 subjects (100 in the seven year old and 100 in the eight year old groups). The mean auditory differentiation score of the seven and eight year old children was 39.59 and 39.79, respectively, showing a significant difference ( $P=0.03$ ). The results showed lower mean score of auditory differentiation among the seven year old children compared to their eight year old children. In this study, no significant difference was observed between girls and boys in terms of auditory differentiation skill ( $P=0.19$ ).

The percentiles of 5 and 95 as well as the minimum and maximum auditory differentiation score of the seven and eight year old children are presented in Table 1.

**Table 1:** The mean, standard deviation, minimum, maximum and percentiles of 5 and 95 as well as the auditory differentiation score of seven and eight year old children

Age (years)	No.	mean	SD	Minimum	Maximum	Percentile 5	Percentile 95	P value
7	100	39.59	0.72	37	40	38	40	0.03
8	100	39.79	0.55	37	40	38.5	40	

## Discussion

The results of this research showed higher mean auditory differentiation among the eight year old children, and the lack of significant difference in auditory differentiation score of boys and girls. As high levels of auditory mechanism are significantly involved in differentiation of temporal differences in sounds [16], and as the development of the central nervous system especially the cortex continues until age 12, the performance of the auditory differentiation skill also develops [17]. Studies also suggest differences in auditory differentiation across different age groups, as well as the importance of age in the development of auditory differentiation skill in children [1, 14, 16, 18-24].

It seems that in addition to age, the cognitive perception development of the children is also efficacious in the performance of tasks related to auditory differentiation. This implies that with increase in age, this performance also increases [25]. The study by Sussman et al., (1993, 2007) indicated that another pertinent factor is the environment. In other words, both the environment and maturity are involved in auditory differentiation skill [2, 26].

In this study, no significant difference was observed in the auditory differentiation score of boys and girls, which is in consonance with the findings obtained by Bakhtiari et al., (2012) on normal 4-6 year old children [14]. In the research by Brancalioni et al., (2012), which examined the relationship between auditory differentiation and phonological disorder among 4-8 year old children, it was found that differentiation of verbal sounds was more difficult for boys compared to girls. Nevertheless, their study cases had phonological disorder, and it was not performed on normal people [6].

## Conclusion

Considering the importance of auditory skill in coping and acquiring the primary stages of language development and the importance of auditory differentiation in the development of speech and language skills of children in central auditory processing, as well as its relationship with articulation disorder and dyslexia, it seems that evaluation and where necessary training on auditory differentiation skill can be efficacious in diagnosing and rehabilitating children with central auditory processing disorder, articulation disorder, phonological disorder, dyslexia, ADHD, ... To this end, having a benchmark score is essential.

## Acknowledgment

The authors immensely appreciate Shiraz University

of Medical Sciences and Ms. Parisa Chamanpara in the Clinical Research Development Center of Namazee Hospital for her support in the collection of statistical data, as well as the authorities, teachers of the school were the subjects attend, the subjects and parents for their cooperation. This paper is adapted from a BSc thesis (proposal code: 95-01-06-12956) in the field of speech therapy.

**Conflict of interest:** None declared.

## References

1. Dsouza JM, Aravind LR. Auditory Discrimination Tests in Konkani-Performance of Children (6-9 Years) in Quiet and Noisy Conditions. *Language in India*. 2016;16(4).
2. Sussman E, Wong R, Horváth J, Winkler I, Wang W. The development of the perceptual organization of sound by frequency separation in 5-11-year-old children. *Hearing Research*. 2007;225(1):117-27.
3. Hoff E. *Language Development*. 148-152. tE, editor2009.
4. Ting H, Yunus J, Nordin MM, editors. Assessing auditory discrimination skill of Malay children using computer-based method. *Engineering in Medicine and Biology Society, 2005 IEEE-EMBS 2005 27th Annual International Conference of the*; 2006: IEEE.
5. Alpinier JG, McCarthy PA. *Rehabilitative audiology: Children and adults*: Lippincott Williams & Wilkins; 2000.
6. Brancalioni AR, Bertagnolli APC, Bonini JB, Gubiani MB, Keske-Soares M. The relation between auditory discrimination and phonological disorder. *Jornal da sociedade brasileira de fonoaudiologia*. 2012;24(2):157-61.
7. Wormith S, Pankhurst D, Moffitt A. Frequency discrimination by young infants. *Child Development*. 1975:272-5.
8. Marquardt TP, Saxman JH. Language comprehension and auditory discrimination in articulation deficient kindergarten children. *Journal of Speech, Language, and Hearing Research*. 1972;15(2):382-9.
9. Schaadt G, Männel C, van der Meer E, Pannekamp A, Oberecker R, Friederici AD. Present and past: Can writing abilities in school children be associated with their auditory discrimination capacities in infancy? *Research in developmental disabilities*. 2015;47:318-33.
10. Jansson-Verkasalo E, Ceponiene R, Kielinen M, Suominen K, Jäntti V, Linna S-L, et al. Deficient auditory processing in children with Asperger Syndrome, as indexed by event-related potentials. *Neuroscience letters*. 2003;338(3):197-200.
11. Baharanchi SA, MohammadBeigi M, Abnavi F, Tavakol S. Design and Implementation of a Tactile Stimulation Device to Increase Auditory Discrimination. *IEEE Transactions on Haptics*. 2017.
12. Lanzetta-Valdo BP, de Oliveira GA, Ferreira JTC, Palacios EMN. Auditory Processing Assessment in Children with Attention Deficit Hyperactivity Disorder: An Open Study Examining Methylphenidate Effects. *International archives of otorhinolaryngology*. 2017;21(01):72-8.
13. Ehrlich CH, Shapiro E, Kimball BD, Huttner M. Communication skills in five-year-old children with high-risk neonatal histories. *Journal of speech and hearing research*. 1973;16(3):522-9.
14. Bakhtiari J DH, Khatoonabadi AR, Ghorbani R. Survey of auditory discrimination skill in 4-6 years old children in Semnan city. *Journal of Modern Rehabilitation* 2012;6(No.2):37-41.
15. Seyf Naraghi MN, E Learning disabilities Tehran Amirkabir Publisher. 1995.
16. Sinnott JM, Aslin RN. Frequency and intensity discrimination in

- human infants and adults. *The Journal of the Acoustical Society of America*. 1985;78(6):1986-92.
17. Webb W, RK A, RL L. *Neurology For Speech Language Pathologist* 2008.
  18. McAdams S, Bertencini J. Organization and discrimination of repeating sound sequences by newborn infants. *The Journal of the Acoustical Society of America*. 1997;102(5):2945-53.
  19. Novitski N, Huotilainen M, Tervaniemi M, Näätänen R, Fellman V. Neonatal frequency discrimination in 250-4000-Hz range: Electrophysiological evidence. *Clinical Neurophysiology*. 2007;118(2):412-9.
  20. Maxon AB, Hochberg I. Development of psychoacoustic behavior: Sensitivity and discrimination. *Ear and Hearing*. 1982;3(6):301-8.
  21. Olsho LW. Infant frequency discrimination. *Infant behavior and development*. 1984;7(1):27-35.
  22. Moore DR, Ferguson MA, Halliday LF, Riley A. Frequency discrimination in children: Perception, learning and attention. *Hearing research*. 2008;238(1):147-54.
  23. Aslin RN, Smith LB. Perceptual development. *Annual review of psychology*. 1988;39(1):435-73.
  24. Cacace AT, McFarland DJ, Ouimet JR, Schrieber EJ, Marro P. Temporal processing deficits in remediation-resistant reading-impaired children. *Audiol Neurootol*. 2000 Mar-Apr;5(2):83-97.
  25. Jensen JK, Neff DL. Development of basic auditory discrimination in preschool children. *Psychological Science*. 1993;4(2):104-7.
  26. Sussman JE. Perception of formant transition cues to place of articulation in children with language impairments. *Journal of Speech, Language, and Hearing Research*. 1993;36(6):1286-99..