

Specifics of auditory perception for children with developmental dysphasia

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Abstract: *Developmental dysphasia belongs in the category of specifically impaired speech development and also in the category of central auditory processing disorders. This article is focused on a partial, theoretical and subsequently practical finding in a review regarding one of the impairments of speech – auditory perception – in children with diagnosed developmental dysphasia. This was also addressed within the issue of central auditory processing disorder and some of its definitions, which were presented by the ASHA (American Speech-Language-Hearing Association) in 1990 and 1996.*

Key words: *specifically impaired speech development, developmental dysphasia, central auditory processing disorder, auditory perception*

1 Introduction to the Issues

The ability to hear, or to listen, is closely linked with the development of a child's speech and, consequently, with its thinking. The child learns to speak by imitating the sounds of human speech. The main precondition of speech imitation is that the speech is heard well. The perceptual apparatus is located in the inner ear and it has the ability to analyze and process the mechanical vibrations of sound waves, change it to a nerve signal and transfer it to the brain. Ergo, this neural signal process in the auditory area of the brain, specifically in the Wernicke speech center, has the ability to perform highly differentiated analysis and synthesis of acoustic stimuli. However, we cannot consider this area as delimited, because the auditory cells are spread over a greater distance. The more distant the auditory cells are from the cortical core of the auditory analyzer, the less their ability is to perform complex analysis and synthesis of speech sounds. (Novák, 2001).

I. P. Pavlov called these cells ‘reserve’ cells, because in the case of a damaged cortical core they function as replacements. The cortical core of the auditory analyzer is capable of the analysis and synthesis of the most subtle sounds of speech. Auditory cells are densest in the core and there they form the strongest connections between themselves. Weaker connections occur in the peripheral parts of the cortical core of the auditory analyzer, therefore, only elemental analysis and synthesis is possible there (Gaño, 1965).

A simplified description of the physiological basis and neurophysiological aspects of auditory perception provides us with the information that the primary circuit of speech crosses the auditory pathway. The reflexes of speech are created through imitation; if we listen, the sound, the speech and so on is strengthened by reflexive repetition – this is physiological echolalia, even when the child hears his or her own speech. The reflexes of speech systematize if a child reaches the age of asking questions, when a child asks about things and events (Lechta, 2003).

2 Periods of Development of a Child’s Hearing

It is very difficult to define what is “normal” hearing development, if we’re talking about humans. Everyone has their own individual development, path and speed. We will introduce some examples of the basic stages of hearing development. A person has an inborn genetic faculty at all positions of auditory processes which enable that person to perceive a sound signal, to filter it according to certain principles and to understand its relevance.

The stages of hearing development in individuals can be observed with the following specifics:

The brain of a human being begins to activate in the seventh week of pregnancy, while the area of the central nervous system, or temporal lobe, begins to develop after the twentieth week of pregnancy. The auditory nerve and cochlea nucleus is fully developed by six weeks after birth. An individual with “normal hearing” makes use of the effectiveness of the auditory pathways to the end of the second year of life and the maturation of the auditory cortex continues into the fifth year of life (Diller, 2012).

The development of hearing is dependent on these factors:

- inner ear function,
- auditory pathways leading from the cochlear nuclei,
- high-level functions of auditory cortical nuclei (Diller, 2012).

If we summarize the latter information within various periods of human development, we can observe the important stages of auditory perception in connection with the development of speech:

I. Prenatal (antenatal) stimulation

The foundations of hearing begin in utero. The human fetus can hear sounds coming from outside of the mother's body; the fetus hears low sounds much better than high sounds and he or she hears the sounds from the interior environment, e.g., the mother's heart beat, her voice, singing, etc.

II. 0–4 months

After birth, the child reacts to its mother's voice; also he or she can be frightened by sudden or strong noises. The movements of his or her eyes, or head, begin to locate certain sounds.

III. 3–6 months

The child is interested in different sounds. He or she experiments with their own sounds. The child ostensibly recognizes familiar voices.

IV. 6–12 months

The child can hum. He or she begins to understand simple words, like "mama" and "papa". He or she begins to understand simple instructions. The child is able to recognize complex auditory stimuli: he or she responds to words such as "mama," "papa," "woof;" to verbal incentives to give their hand, point to their nose, etc. Passive language is developed before active speech at this age.

V. 12–18 months

The child's babble begins to form his first words. He or she can use about 20 words, and understands about 50 words.

VI. 2 years

The child usually speaks in simple sentences and uses about 200–300 words. He or she likes reading, recognizes pictures and can name many things.

VII. 3–4 years

The child uses words and sentences to express its needs, questions and feelings. Vocabulary, pronunciation and understanding increases significantly during these years. (Jedlička, Škodová, 2003).

It is important to notice that the child is progressing gradually and fluently through all the stages of development, rather than to focus attention on the presence of a specific stage at a specific time.

3 Central Auditory Proccesing Disorders (CAPD)

Insufficient auditory perception of children with specific language impairments is associated with Central Auditory Proccesing Disorders (CAPD). In the fifties of the 20th century, Mylkebust stated (in Smith 2001) that hearing is a normal process within standard language behavior. He also noted that during diagnosis of the central

processing of speech signals, we focus only on the peripheral lesion, and therein lies the central damage.

Since then, diagnosis has been enriched with investigative methods that can reliably determine the central processing disorder of speech signal. Hall and Mueller (in Smith, 2001) reported in 1997 that around 70 tests exist, which are used especially in English speaking countries. The best known tests are: the binaural fusion test, the sentence completion test, dichotics tests, discriminatory tests, comprehension during noise interference, and others.

The diagnosis of disorders within CAPD is complex and time consuming (Smith, 2001). In the Czech Republic we use tests which are aimed at determining the leading ear (Dlouhá, 2003). This test observes whether the client understood the word in both the right and left ear. Furthermore, the test focuses on short sentences, of which one part is reproduced for the right ear and the other part of the sentence is reproduced for the left ear, after which the client has to compose the sentence. Other tests are used without a verbal base, where there are tones varied in length – PATTERN Pitch Sequence – PPS. (Novák, 2001). These tests are implemented mainly by ENT specialists and paedaudiologists.

Currently, in their practice, school speech therapists and Czech speech therapists encounter developmental dysphasia, which belongs to a group of specific impaired developments of speech. Most of the current authors in etiology label the cause of developmental dysphasia disorder as Central Auditory Processing Disorder, or CAPD.

The wording of “speech signal processing” was and is the subject of many discussions between audiologists, speech therapists, psychologists, teachers and parents. Terms such as “central processing of speech signals,” “central auditory processing,” “phonological processing” and “temporal processing of auditory perception” are used in the sense of how people perceive speech, how it is understood, interpreted and they respond to questions about how heard patterns are recalled and introduced. The American association, ASHA (American Speech-Language-Hearing Association), published definitions in 1990 and in 1996 which provide detailed information about the complexity of these processes and their deficits. The 1990 definition includes a description of the behavioral correlates involved in processing that ultimately correspond to the neuroanatomical processes involved in processing linguistic and non-linguistic acoustic information.

The definition from the year 1990 describes the neuroanatomical processes which are involved in processing language and nonverbal acoustic information. Central auditory processing disorders in the area of sound signals include the perception, language and cognitive functions, which, with relevant interaction, lead to effective communication and speech perception, conscious and unconscious, as well as the mediated and unmediated ability to participate, discriminate and identify acoustic signals. It is a process of transformation and continuous transmission of information

over the peripheral area to the central nervous system. Here, the information filters, ranks and combines information into an appropriate perception at the conceptual level. The information is then saved and read efficiently using the phonological, semantic, syntactic and pragmatic knowledge, where it joins the meanings of various acoustic signals through the use of language or non-language context (Fahey, 2012).

Another opinion can be found in the definition of CAPD from 1996. Central auditory processes are the auditory system mechanisms and processes responsible for the functioning of the following phenomena: localization and lateralization of sounds, auditory pattern recognition, perception of sounds in time, and their resolution in the background with competing or incomplete acoustic signals. These mechanisms and processes expect and relate to the non-verbal and verbal signals, as well as affect many areas of functioning, including speech and language. They are of a neuro-physiological nature. Most neurocognitive mechanisms and processes are involved in identification and discrimination tasks. Some of them are specially designed for acoustic signals, while others – such as attention, the long-term process of linguistic concentration – are not. In light of those mechanisms and processes, the term “central auditory processes” relates primarily to acoustic signals.

The second definition determines the auditory standpoint of processing, but it assumes the difference in terms of language processing that is not dependent on the acoustic signals. This difference leads to a wider debate about language processing. We should be aware of other kinds of communication that we use for reception, perception, analysis, storage, extraction, formulation and development of language. For example, by using sign language deaf people can communicate and understand messages. They process language with a disrupted auditory system. Written language is another way which the process of language does not require a direct audio input. Reading and writing, however, requires the knowledge of words, speech and language, but the development of these abilities is possible even without auditory sensations. These examples show that language processes go in tandem – depending on the processing of auditory signals, but also independently of them (Fahey, 2012).

4 Phonemic Hearing as Part of Auditory Perception

Phonemic Hearing (the term “phonemic awareness” is used, more often in foreign literature) is the area of auditory perception which leads to the subtle auditory discrimination of phonemes.

Lechta (2005) presents that “phonemic awareness is the most comprehensive level, the most complicated level of the phonological processes, and that it is therefore the strongest indicator of phonetic-phonological abilities in children”. (Lechta V. et al. Treatment of communication disorders, 2005, p. 176).

Phonemic discrimination of phonemes of a mother language is a process that begins to develop around the eighth month and it accompanies the child throughout its speech development. Various authors do not agree with the age distinction border of phonological matching and they state a different age limit.

Mikulajová (2003), for example, lists the following stages of development of phonemic hearing:

- The period of rhymes begins around the third year of age,
- A child can compare the verbal basis of rhyme (alliteration in words, starting off the same, ending the same),
- A child has a feel for the rhythm of words at pre-school age, it begins analysis and synthesis of words, and can separate a word into syllables,
- A child, before entering school, can single out a phoneme in a word and he or she can identify a phoneme at the beginning or the end of words, he or she becomes able to analyze and synthesize phonemes in a word,
- School age is the time when a child reads and writes and becomes aware of the manipulation of phonemes: the substitution, omission, modification of phonemes.

Various tests were created to examine phonemic hearing, to identify its quality, and also to identify deviations and disorders. Here are some of them:

- Phonemic awareness screening – M. Mikulajová (2003).
- Auditory differentiation test – JM Wepman, in 1987, then edited by Z. Matějček.
- Examination of phonemic differentiation – Lechta V., 1995.
- Examination of phonemic hearing – in 1995, Škodová, Michek, Moravcová.
- Auditory discrimination of phonemes – J. Dvořák.

Nowadays, there are whole sets of tests; there are exercises for correcting and strengthening phonemic hearing and these are the subject and the trend of modern speech therapy.

5 The Specifics of Auditory Perception for Children with Developmental Dysphasia

It should be noted that a child with developmental dysphasia has therefore “normal hearing,” but the problem is manifested in the interpretation and the subsequent processing of speech. The disorders are significant to the understanding and usage of individual sounds and of acoustically similar sounds, in the perception and in the determination of sounds at the beginning and the end of words with these sounds and syllables. There are often disorders of perception, memorizing and reproduction of rhythm, of the intonation and of the melody. (Škodová, Jedlička, 2003).

We have to recall and take a close look at the area of auditory perception, which includes the auditory processing of speech. Dvořák (2003), characterizes the difficulties in auditory performance for children with developmental dysphasia. They are:

- Localization and lateralization of sound: the knowledge of where the sound is produced,
- Auditory memory: the ability to remember heard patterns,
- Auditory discrimination: distinguishing the similarity and differences in sounds,
- Hearing: time processing of signals and speech,
- Auditory perception: the ability to receive sounds, words and understand them,
- Recognition of auditory patterns: the ability to identify sound patterns and identify them, for example: motor cars,
- Hearing figure and background: the ability, even with the interference of background noise, to choose the basic, important information.

Novák (2001) refers other areas, where children with developmental dysphasia have deficiencies. They are:

- hearing – vocal association: the ability to draw what the child hears, and then verbally respond to spoken words,
- hearing – vocal automaticity: the ability to predict word reversals according to previous language experience,
- auditory synthesis: the ability to combine the sounds, which they hear, and join these in units or analyze a word by its individual components.

The central processing of speech signal disorders is a disorder which affects the whole range of speech in all its components.

This part of the article is devoted to the specifics of auditory perception for children with developmental dysphasia.

We often encounter the personal histories of children with developmental dysphasia, because the mother reports: “He developed normally, and began to talk at two years, but after this time something happened and then he couldn’t speak like his peers,” “He has no interest in storytelling”. The question arises: “Why did he normally speak and then something happened?” Auditory perception very significantly affects not only the development of speech communication, but subsequently its learning, especially learning to read, and it is also important for the education and exercise of communication skills.

The children with developmental dysphasia has the deficiencies in the auditory perception difficulties in these areas, that are crucial for in-school speech therapy diagnosis:

1. In phonemic hearing and in the resolution of initial and final phonemes in words, the child doesn’t distinguish the phonological differences between sounds – for

example: koza/kosa, balí/valí – problems occur in pronunciation, in recognizing familiar and similar sounds, and the child makes mistakes with diacritical marks on long vocals. The child makes errors by confusing voiced and unvoiced consonants, in sibilant substitutions, and has problems distinguishing the syllables di-ti-ni, dy-ty-ny.

2. The child has problems with concentrating and with the ability to listen: most of the information comes through hearing, the children do not have an active interest in reading fairy tales and stories, listening does not work in ears, there are problems also to listen to instructions, commands, and for specific actions in order to implement several tasks in order.
3. The child has problems to analyze and synthesize words, is not able to distinguish monosyllabic from multisyllabic words, does not divide words into syllables, does not connect parts of the words into a whole, cannot complete words, cannot distinguish the root of a word which can be derived from the given word, and is unable to analyze and synthesize abstract words and unknown words.
4. Problems in the resolution of figures and background: this is the situation when the child has a problem to focus his or her attention away from sounds in the background when the background is distracting – such as the sounds of cars from the road, the voices of children on the playground – in which cases the child is not able to concentrate on the auditory stimulus which is specified for further processing, and so the child fails to recognise the auditory stimulus and give it due attention, thus the child is easily disturbed by any other sound stimulus.
5. The child has difficulties with auditory memory: he or she has problems learning children's poems, rhymes, is deficient to remember instructions, hear the word and sentence patterns, the deficiencies manifesting themselves in the remembrance of words with a visual component to the model of listening, so this weakness is reflected in written language where the child is not able to write correctly without visual support, as in the case of dictation.
6. The child also has problems with mathematical concepts: the problems may be reflected in the understanding of number sequences, multiples, and the child has difficulties with their perception of rhythm where they have problems clapping to a beat, or marking the syllables in words.

The stated applications of auditory perception are only a fraction of the factors which affect the ability to learn, to speak in contained and syntactically correct sentences, read, write, and think within a time sequence. The diagnosis of developmental dysphasia is necessary and requires further testing of motor skills, the general psychomotor development of the child, other levels of speech and in the framework of differential diagnosis it is also important to cooperate with experts from the areas of neurology, ENT specialists, psychology, speech therapy and to avoid problems with

other forms of communication skills such as: delayed speech development, mutism, mental retardation, autism.

The overall and, especially, the speech development of a child with developmental dysphasia is very long and exhausting, and it demands patience on the part of the child itself, as well as from parents and professionals. Even through the smallest accomplishments and firm conviction, all those involved are motivated towards further reeducation work.

6 Conclusion

The aim of this article was to write a partial view on the issue of auditory perception for children who have a diagnosis of developmental dysphasia. It is necessary to approach each child individually. It is also important to obtain a high-quality, detailed case history for each case, because individuals have different problems, different ranges of specific non-linguistic and linguistic information, and they come to speech therapists at different ages in different stages. The strategy of re-education is aimed at every child with developmental dysphasia, and is directly "tailored" to each child.

The presence of central auditory processing disorders includes signal interference with the goal to eliminate the disability and move the child at all language levels to the highest point, to where one can communicate seamlessly. This is a difficult task for all, especially if the child has to successfully cope with his or her entrance to primary school.

It is a clear advantage for such a child with this diagnosis to be included in a mainstream school. The interdisciplinary cooperation of teachers and participation of all professionals will be necessary to their reeducation, training and the educational processes of the child. We wish them all satisfied children!

7 Literature

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