COGNITIVE GROUND OF THE AUDITORY MODALITY

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The abstract views the cognitive ground of natives and adoptees' auditory speech perception. Here, the auditory modality is a mental gear based on auditory receptors, memory and attention perceiving and processing auditory stimuli due to their acoustic characteristics and phonological representation. The abstract shows the specificity of natives and adoptees' auditory modality, in particular the selective auditory attention and mismatch negativity providing auditory stimuli discriminability.

Key words: *auditory modality, phonological representation, auditory receptors, selective auditory attention, memory, mismatch negativity.*

In psycholinguistic studies [1; 2; 3; 4; 7 et al.], speech perception is considered to be a sequence of interconnected neurophysiological processes aimed at comprehension of an auditory stimulus. Speech perception and comprehension ground on the auditory modality (AM) – a mental gear that perceives and processes the auditory stimulus via auditory receptors, attention and memory. In this system, the sensory receptors perceive acoustic signals, while memory and attention provide congruent speech comprehension.

Our view of AM bases on the following issues [1; 2; 4; 5; 6; 8 et al.]. First, auditory speech perception does not occur momentarily but results from many operations carried out during auditory speech processing. Next, the nervous system cannot simultaneously and fully support all aspects of sensory stimulation because of the recipient's limited ability to store and process sensory data. What ultimately brings us to the need to explain *how* different types of attention and memory, along with auditory receptors provide auditory perception and parsing of information by both native speakers and adoptees? Finally, defining the implicit and explicit nature of AM will boost the understanding what is the difference between auditory perception of a native speaker and a bilingual.

AM of a native speaker successively forms up to a certain age, gradually acquiring the implicit status along with other native tongue primes. Whereas bilingual's AM is mostly acquired explicitly preconditioned by L1 phonetic and phonological primes. Studies about the age specificity of auditory speech perception [1, p. 208] show that L1 phonological representation knowledge acquired in childhood make an important mechanism of the implicit memory. Evidently, this particular knowledge reasons the interference in L2 speech processing and primes the emerging of L2 phonological representation system.

Researchers [4; 7; 8; 11 et al.] have concluded that even before birth the foetus responds to sound signals mainly of mother's voice and recognizes some sound changes. Immediately after birth, babies are capable to distinguish some speech sounds and intonation. To the age of three-four months develops the infant's right ear responsible for speech perception. The vital importance of this ability lies in the fact that the main areas of language in the brain for most people locate in the left hemisphere, to which the right ear provides the most direct access. At the age of five months, babies can interlink visual and auditory information. The ability to perceive prosodic utterance limits develops at about sixth months. In the period of about eight to ten months, infants clearly distinguish L1 tones rhythmically structured. Infants' ability to discriminate L1 and L2 sounds is implicit for natives as it is acquired at an early age period of phonological sensitivity and explicit for bilinguals especially if they started L2 acquisition in adulthood (usually after the age of eight).

At each age stage of AM development, individual attention and memory are of a particular importance. D. Hubel et al. (1959) first studied the role of attention in auditory information processing by natives [9]. Results of the study showed that the response of neurons in the cerebral cortex during speech perception are exposed to significant modulation caused by the auditory attention. This research marked the beginning of further studies [3; 4; 7; 10; 11 et al.]. Hence, in "Auditory attention – focusing the searchlight on sound" Jonathan B. Fritz et al. (2007) reveals that at the moment between the initial perception of sound stimuli until the focused attention activation, the distinction of linguistic and non-linguistic acoustic signals takes place. Therefore, the auditory extraction relies on the selective auditory attention as well as the auditory memory and auditory perception [7, p. 2].

In particular, the selective auditory attention (SAA) segregates and inhibits auditory stimuli for certain acoustic characteristics. The most relevant acoustic characteristics of speech, which activate SAA, are fundamental frequency, intensity, duration, and rhythm [8; 11; 13].

Psycholinguistic models of speech perception and comprehension [9; 13; 14] show that SAA focuses on a definite speech segment most prominent due to the particular auditory feature. The recipient integrates temporarily dispersed features of the auditory stimulus in the one most prominent feature. Next, he integrates the speech flow into certain clusters due to the relevant acoustic characteristics [5; 9]. SAA models cluster mental representations of sound stimuli coming from the auditory environment, i.e. the auditory objects [1, p. 202]. SAA discriminates and links auditory objects joining dispersed auditory stimuli to keep them in focus.

Results of the dichotic listening researches [1, p. 203; 5, p. 33] show that due to SAA, acoustic objects are perceived as coherent auditory stimuli, sense monoblocks providing speech congruence and discriminability. In native's speech processing, SAA promptly and accurately directs perception focus on relevant acoustic stimuli unintentionally / involuntarily, i.e. implicitly, whereas SAA activation for most bilinguals is extremely explicit and intentional / voluntary [1; 3]. Perceiving the stimulus intentionally, the auditory information processing, behavioural response, and overall responsiveness of the adoptee largely depend on SAA voluntarily providing identification and clustering of the auditory stimuli in speech flow based on priming, i.e. implicit speech experience of the individual [1, p. 203].

SAA also incorporates the so-called acoustic 'novelty' detection system necessary for the auditory speech perception – an automatic, pre-attentive component that assists in parsing the acoustic scene and discriminates stability and novelty [8]. The acoustic 'novelty' detection system correlates with mismatch negativity (MMN), i.e. 'a negative stimulus in the deviant event-related brain potentials response that occurs about 150–200 ms after stimulus onset, evoked by a deviant stimulus in a sound sequence in contrast to the repeated standard sound'. MMN continuously monitors the auditory environment, tracks changes, and dynamically updates the representation of the acoustic scene and is likely to be composed of parallel sensory (refractory-response-based) and cognitive (memory-comparison-based) components [10]. The source of MMN may shift depending upon the auditory areas analysing the deviant acoustic change. MMN triggers due to spectrotemporal fluctuations.

Accordingly, L1 AM emerges at an early age in the period of the highest phonological sensitivity as the implicit knowledge further priming speech processing. For adoptees, especially in their adulthood, AM is acquired explicitly which is based on previously gained L1 experience. A key role in AM belongs to voluntary and involuntary attention, selective auditory attention, implicit and explicit memory. Particularly important elements of AM are SAA and MMN that provides auditory stimuli discriminability.

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