HEMISPHERIC CONTRIBUTIONS TO PROCESSING AFFECTIVE AND LINGUISTIC PROSODY

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ABSTRACT

The purpose of the study was to reveal cerebral hemispheric engagement in the perception of Russian prosody - affective and linguistic. Stimuli were presented monaurally. Listeners were normal adults with symmetrical hearing. The results evidenced by shorter reaction times show right-hemispheric prevalence for affective and 'idiomatic' prosody. Recognition of communicatively different prosodic types needs different kinds of asymmetry in males and females.

INTRODUCTION

For decades the left cerebral hemisphere was traditionally described as playing a major role in language functions in most individuals. The right hemisphere, however, has been demonstrated to posses considerable linguistic capabilities. It has been shown in dozens of studies carried out both in neurologic and psychiatric patients as well as in normal subjects via special techniques like dichotic, monaural and tachistoscopic stimulation. Recent neuropsychological data demonstrate contradictory character of the state of the art, partly because of the methods and models that are difficult to compare. Studies in both normal and brain-damaged subjects support with a high degree of consistency the role of the right hemisphere for emotional sphere, while hemispheric involvement in processing linguistic prosody is less clear [1-4]. Although disordered expression and recognition of emotional prosody has recently been associated with damages to the cerebral hemisphere not specialized for language itself there were notions that dysprosodic production has also been associated with left-hemisphere impairments [5-10]. On the other hand, most of the findings tend to support the idea of syncretic, holistic perception, characteristic of the right hemispheric mechanisms. Emotions - not only verbal - are proved to be the right hemispheric privilege. We also know that the right hemispheric Gestalt (cognitive and linguistic) mentality is similar to that of a child [11]. The adult listener - similar to the child in the early stage of language acquisition - starts speech processing with breaking up the spoken text into 'chunks', i.e. perceptually coherent configurations of auditory events suitable for further analysis (on the basis of stress, rhythm, etc.). This shows that the right hemisphere should be engaged into all kinds of prosodic processing, not only affective.

Our objective in this study was to reveal evidence of hemispheric specificity for the perception and understanding of different types of Russian affective and linguistic prosody in normal adults.

MATERIALS AND METHODS

Subjects

Listeners were normal adults with symmetrical hearing (thresholds of 15dB level or better for all frequences), all native Russian speakers, monolinguals and right-handers with no familial sinistrality, aged 21- 51, 7 males, 7 females.

Stimuli and Procedure

The prosody comprehension test used monaural stimulation of either the left or the right ear, contralateral ear being masked by white noise, produced by a function generator. The stimuli were natural speech utterances of 26 Russian phrases randomly ordered and played on an audiotape. Samples were those expressing emotions (surprise, politeness, anger, delight, request, etc.) as well as lexically identical but communicatively and syntactically different (declarative, interrogative, imperative, with different focal accents and syntagmatic division, some of them being well-known to listeners, 'idiomatic', some - artificially composed but grammatically correct):. e.g."He has told me." vs. "He has told me..."; "Stand there?" vs."Stand there!"; or "*John* went to Moscow yesterday"vs. "John *went* to Moscow yesterday" vs. "John went to *Moscow* yesterday' vs. "John went to Moscow *yesterday*"; or "*Drink*, not gargle" vs. "Drink not, *gargle*" etc.).

Headphone left- right orientation was switched at random. Initial orientation was alternated across subjects. Every stimulus, therefore, was presented, in the left and the right ear. Subjects were instructed to ignore the competing noise and monitor the stimulus, and to choose one of the response cards as soon as the decision was made. All instructions to subjects were recorded on the stimulus tape. The reaction time and the number and character of errors were registered.

RESULTS AND DISCUSSION

All subjects demonstrated correct recognition and understanding of the stimuli at each ear with rather few errors committed. However, the reaction time appeared to be a relevant feature, showing relative ear advantage. For each listener, the percentage of quicker recognition for each phrase and for a set of similar phrases (a prosody type) at each ear was calculated. To investigate patterns of lateralization for males and females we calculated for each of the groups the difference in performance at the two ears for each prosody type to reveal ear advantages (Fig.1 and 2).

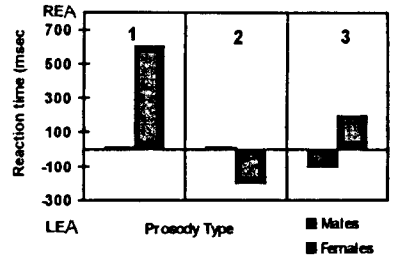

Fig.1 Ear advantages in mean perception latencies (1-'novel', 2-'idiomatic', 3-'communicative')

The overall analysis of the data showed no significant ear advantage. However, when we grouped the data in accordance with more detailed prosody types we saw evidence of more selective hemispheric involvement. Specifically, the performance was quicker when the *affective* stimuli were presented in the left ear (which is in keeping with the earlier findings), with asymmetry more evident in males. Reliably asymmetric was the processing of lexically identical but *communicatively differing* phrases in males compared to females (reliable left-

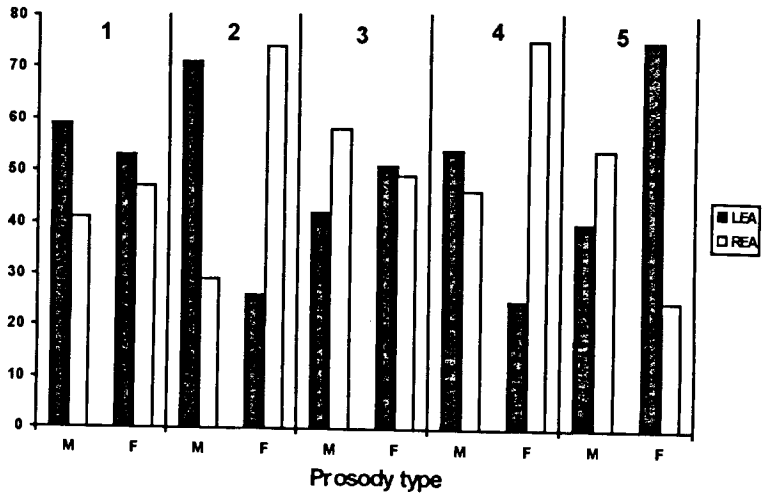

Fig.2 Percentage of phrases perceived with shorter reaction time (M- males and F- females, 1- affective, 2- communicative, 3- syntactic, 4- 'novel', 5-'idiomatic')

ear advantage in reaction time in males and right-ear advantage - though not significant - in females.). Recognition of *syntactically different* phrases showed statistically reliable right-ear advantage in males and less reliable left-ear advantage in females.In females different sentence accents, indicating difference in *syntagmatic division*, revealed right-ear advantage for '*novel*' contrary to left-ear advantage for the recognition of '*idiomatic*', '*trivial*' '*Gestalt*' samples. Less obvious was the asymmetry in males.

In summary, the results of the study offer evidence of the involvement of both cerebral hemispheres in processing prosodic information in normal subjects. Nevertheless, the data suggest that specific hemispheric prevalence in the processing is caused by several factors. Among them are *the stimuli-factors* (linguistic and cognitive - or pragmatic - features; 'novelty' acompanied by analytic functions of the left hemisphere, contrary to 'iconicity' - adequate for the right hemispheric global template recognition), and *the subject-factors* like individual psycho- physiological characteristics - age, emotional status and sex differences (resulting from cytoarchitectonic and neurochemical peculiarities). Similar to [4] our investigation indicate that prosodic processes are made up of multiple skills and therefore such functions are distributed across cerebral systems rather than strictly lateralized to a single hemisphere. We also claim that the function served by a stimulus rather than its physical nature determines laterality of processing [cf. 12].

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