CENTRAL MECHANISMS OF INTONATION PROCESSING - COMPREHENSION AND IMITATION

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ABSTRACT

It is now well recognized that the right hemisphere is concerned with processing of prosodic features of speech - intonation, rhythm and stress. There are however contradictory data concerning linguistic prosody as most of the research involve affective stimuli only. The paper deals with neural aspects of both kinds of prosody in normal listeners. The results show hemispheric specialization for linguistic and affective prosody, the latter being a complex continuum.

1. INTRODUCTION

A role of the right hemisphere in the mediation of emotional speech was shown as early as 1874 by H.Jackson who observed that emotional words (i.e. cuirses) were selectively spared in some groups of aphasics. In 1947 J.Monrad-Krohn demarcated the processing of affective and linguistic prosody. He was one of the first to show right hemisphere dominance for emotional characteristics of speech. During the past twenty years a special role for the right hemisphere has been demonstrated for emotional processing, based on studies examining expression and understanding of emotion in brain-damaged patients and normal subjects. Nevertheless in the majority of papers comprehension and production of intonation as a whole is still being associated with the function of the right hemisphere, "intonation" interpreted by brain- specialists as emotional characteristics of speech, linguistic intonation being neglected. There are a lot of contradictory data, showing not only right hemisphere, but left hemisphere involvement in processing intonations of different types. Some results are difficult to interpret because of the principle difference in investigation procedures, stimuli sets, types of questionnaires, etc. In fact there is no adequate hypothesis for laterality of any prosody yet. The present paper covers part of a cross-cultural investigation of hemispheric role of processing affective and linguistic prosody carried out in normal subjects and in brain-damaged patients. The aim of the study is to clarify the extent to which traditionally known right hemisphere involvement in the process is adequate.

The paper deals with neural representation for the perception and imitation in normal listeners.

2.METHOD

2.1.Subjects.

Male and female adults, postgraduates, aged 20-50, right-handed.

2.2. Stimuli.

The stimuli were Russian phrases of different prosodic types - both linguistic and affective. The set was formed of (i)communicatively different phrases, designating types distinguished from each other by intonation alone; (ii)syntactically different phrases - declarative, interrogative, imperative, exclamatory, etc. (iii)phrases with differing sentence accents, depicting semantic factors and revealing communicative centers of the sentence - arbitrary syntactic complexity with meaning differentiating prosody; (iiii)emphatic prosody types, expressing surprise, politeness, anger, delight, etc., all chosen at random. The stimuli were read and recorded by a professional.

2.3.Procedure.

Every subject was listening to the same recording. The stimuli were presented monaurally to either the left or the right ear in random order, noise being presented to the other ear. After the presentation of every sentence subjects were asked to choose one of the answers printed on the test-cards. The reaction time and types of answers were registered.

3.RESULTS.

The data demonstrate right-hemisphere advantage for processing emotional stimuli - there were significantly fewer errors and the shortest latent periods when the stimuli were presented to the left ear than to the right one. Communicatively or syntactically different phrases appeared to be a complex perceptual domain - some intonation types -"analytical" -seem to involve left hemisphere, while the others -"Gestalt-like"- show a privileged role of the right hemisphere. Sentences of different phrase accents showed surprising laterality effects -the majority of subjects revealed left-hemisphere dominance according to reaction time and correctness of answers. This stands in marked contrast to the results for prosody perception reported earlier. Adequate imitation of prosody did not reveal definite right hemisphere superiority as it could be expected a priori. It appeared that cognitive and communicational validity, the degree of syntactic complexity and novelty can produce strong effect on hemispheric preference.

4.CONCLUSIONS.

Our previous research demonstrated that right-hemisphere mechanisms may be responsible for adequate actual sentence division and for other semantic factors needed for sentence interpretation (e.g. prosodic expression of given/new distinction - functional sentence perspective). Our experiments in linguistic

competence show that cerebral hemispheres play essentially different roles: the right one operates largely with extralinguistic reality, it relates sign to its different. The left hemisphere interrelates signs, refines the process of speech production. In analyzing grammar it uses transformational rules while the right hemisphere uses "given/new" strategy, which in Russian may be provided by the definite word order of specific prosody - the fact that has never been investigated in the light of hemispheric specialization.

The findings under discussion suggest that not only linguistic prosody may be associated with left hemisphere mechanisms versus right hemisphere mechanisms as emphatic but that linguistic prosody itself is most possibly divided between the hemispheres depending on the semantic factors.

In our study we find evidence for left-hemisphere preference for the linguistic types of prosody and right hemisphere preference for emotional prosody, which is in accordance with literature data from brain-damaged patients. The most informative appeared to be sentences of different actual sentence division. The perception of such phrases demonstrated surprising laterality effects - the majority of subjects revealed left hemisphere dominance for complex phrases that needed special analysis versus right hemisphere dominance for wellknown, previously familiar "Gestalt-like" phrases, psychologically "idiomatic".

We consider these findings to be of interest because of several factors: (i) normal subjects used for the procedure, (ii) linguistically balanced stimuli, (iii) new type of procedure - noise for masking the other side of perception, reaction-time measuring, specially designed "answer-cards", etc.

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