Language-specific automatic auditory processing: Evidence from Mismatch Negativity (MMN) studies

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Introduction

Over the past decades, many researchers have hypothesized that the processing mechanisms for linguistic information may somewhat differ from those dealing with other types of input. However, our knowledge about central-auditory (language-specific) processing in- and outside the focus of attention is still rather limited. In particular, one question under debate is whether and how top-down feedback influences early stages of pre-attentive information processing (Schröger et al., in press).

Review

Correct speech perception is based on language-specific memory traces, developed during language acquisition and represented in long-term memory (Näätänen, 2001). It is suggested that speech is a specialised type of complex auditory input. Investigations using the MMN or MMNm provide evidence that not only single or gestalt-like acoustic features/feature combinations are automatically extracted from the sensory input stream, but even abstract linguistic categories like phonemes and morphemes are represented in the early low-level auditory system.

<table>
<thead>
<tr>
<th>Linguistic categories</th>
<th>Selected Mismatch Negativity studies</th>
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<tr>
<td>• Phonemes</td>
<td>Jacobsen et al. (2003), Shestakova et al. (2002), Phillips et al. (2000), Dehaene-Lambertz (1997)</td>
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<tr>
<td>• Grammatical morphemes</td>
<td>Shtyrov &amp; Pulvermüller (2002a)</td>
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<tr>
<td>• Lexical morphemes/words</td>
<td>Jacobsen et al. (in press), Shtyrov &amp; Pulvermüller (2002b), Korpilahti et al. (2001), Pulvermüller et al. (2001)</td>
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Discussion

The reported MMN data suggest that abstract linguistic features trigger central-auditory processes specific for speech encoding. Moreover, there might not only be a language-specific processing of auditory stimuli, but that the processes involved might even depend on the specific language.

Kohls & Zachau et al. (2003) propose a language-specific tuning process, probably such as a ‘lexical effect’, that influences the establishment of the auditory stimulus representation (see figure). A similar suggestion is made by Jacobsen et al. who found that “even when not attending to a given stream of speech, we still establish whether its elements are 1) legal and 2) meaningful in our own language” (in press, p.23).

The ‘language-specific tuning effect’

To conclude, in speech perception top-down processes which are based on the knowledge of complex linguistic patterns might be of great importance even at the early stages of discrimination and selection mechanisms.

References

- Näätänen, R. (2001). The perception of speech sounds by the human brain as reflected by the mismatch negativity (MMN) and its magnetic equivalent (MMNm). Psychophysics, 38, 1-21.