

Lexicality and Not Syllable Frequency Determine Lateralized Premotor Activation During the Pronunciation of Word-Like Stimuli - An fMRI Study

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Left lateralized premotor activations were observed for the pronunciation of visually presented pseudowords relative to real words in a previous PET experiment (1). The aim of this fMRI study was to (a) confirm this finding and (b) improve our understanding of the factors determining these activations. In particular, we were interested to know whether the PET result could be due to the presence of phonotactically legal but infrequent or even novel syllables in the pseudoword stimulus set, which required the assembly of a syllable motor code, whereas in the case of known syllables such a code might have been retrieved from a mental 'syllable inventory' (2).

Subjects and Methods

To test this hypothesis, four sets of bisyllabic stimuli were prepared varying independently both the factors 'words (W)/pseudowords (P)' and 'high (H)/low (L) syllable frequency in spoken language'. Pseudowords were created by rearrangement of the syllables of the word set. Eight male native right-handed speakers of German, who gave written informed consent, participated in the experiment. fMRI was conducted on a 1.5T scanner (Siemens Vision) using dynamic Echo-Planar Imaging (TR/TE/flip angle/voxel size=3s/66ms/90°/3x3x5mm). 16 contiguous slices were selected, paralleling the AC-PC plane and spanning almost the entire cerebrum. Subjects underwent eight stimulation sequences during fMRI, each sequence alternating baseline and two different activation conditions in the order BA₁A₂A₁BA₂A₁A₂B (with B=baseline, A₁-A₂=activation conditions, i.e. HW-HP, HW-LW, LW-LP, LW-HW, HP-HW, HP-LP, LP-LW, or LP-HP). During the baseline condition, subjects viewed length matched strings of false fonts, controlling for visual feature input (3), and said the word "nächstes (next)" to every stimulus. To reduce motion artifacts, all stimuli were read out in a whispering voice. Each epoch of a condition lasted 30 sec (15 stimuli). Data analysis by SPM96b included realignment, correction for global signal intensity variations, normalization into standard stereotactic space, spatial smoothing with an 8mm isotropic Gaussian kernel and statistical comparisons with a significance threshold of $p < 0.001$ (uncorrected) and a cluster threshold of 2 contiguous voxels.

Results and Conclusions

The data of one participant had to be rejected due to unsatisfactory anatomical standardization results. In all of the remaining seven participants left lateralized premotor activations (BA6/44) similar to those obtained in the PET experiment were replicated when comparing syllable frequency matched pseudowords to words. Conversely, direct comparisons of LP versus HP and LW versus HW did not show any left lateralized premotor activations. The conjunction HN-HW with LN-LW was highly significant in all seven subjects. The data provide clear evidence that the activation of the left premotor cortex observed for pseudoword relative to word pronunciation is independent of syllable frequency. This finding is not consistent with the hypothesis that the premotor activations are related to the assembly of syllable motor codes. The activations are more probably related to the nonlexical phonological recoding required by written pseudowords before the processing stage of syllabification. Alternatively, the findings could be explained assuming the possibility of stored *word* motor codes reducing the articulatory processing load for existing words.

References

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