IMPLICIT INTONATION MODULATION OF PRIMING IN AUDITORY RELATED BRAIN AREAS - AN fMRI STUDY

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Background: Repetition priming refers behaviorally to enhanced performance accuracy with shorter reaction latency for repeated stimulus. In fMRI, repetition priming is usually correlated with reduction in activity (repetition suppression) in areas engaged in the modality specific perceptual processing or in amodal conceptual processing of the stimuli. Studies of visual processing of words showed repetition suppression in visual cortex areas that was diminished by prime-target changes of visual features such as font or case (1). Surprisingly the repetition suppression in modality specific *auditory* related brain areas has not been demonstrated as well as the effect of the modulation in perceptual properties of the repetitive auditory presentation of words, like their pitch, on the extent of priming. The priming was demonstrated only in multimodal auditory stimuli combined with extrastriate visual cortex or with frontal and temporal cortex (2).

Aims: 1. To investigate whether repetition priming can be demonstrated in auditory related brain areas in response to repetitive auditory presentation of lists of words. 2. To find out whether perceptual modulations of the pitch contour (intonation) of words, which were organized in repetitive lists, modulates patterns of neuronal repetition priming.

Methods: Nine subjects (6 males and 3 females) participated in the study. fMRI measurement of T2* weighted BOLD contrast (TR/TE 3000/35, FA 90^o, SW 3 mm, 0.4 mm gap, FOV 22 cm, matrix 64X64 resulting in 3.4X 3.4 mm^2 in plane resolution) were acquired using 3T MRI (GE EXCITE 3 HD) and 8-channels head coil. The block design auditory paradigms included two tasks of semantic categorization of words, organized in three repetitive blocks of word lists. In each task, three types of modulations in the words' intonation were tested: 1. monotonous modulation (all the words had the same flattened pitch of 122 Hz along their complete duration), 2. consistent modulation (with preservation of specific intonation for each word in its three repetitions) and 3. continuously changing modulation (each word had three different intonations in its three repetitions). All modulations were synthesized using the Praat software package, which provides convenient means to specify a modified F0 contour as a piecewise-linear curve. Behavioral data of mean reaction times was collected concomitantly with the fMRI scan. Activation maps were processed using SPM2 software, with Marsbar toolbox for ROI analysis.

Results: Fig 1 demonstrates all the activations induced by the paradigm. ROI-based statistical analysis was performed for primary auditory cortex (BA 41, fig 2 a, c, e) and superior & middle temporal lobes (BA 21 22, fig 2 b, d, f). Significant repetition suppression was demonstrated bilaterally in these areas for repeated auditory presentations of words in an identical flattened monotonous pitch, using a semantic categorization task (fig 2 a, b). We further found that prime-target modulation of a spoken word's pitch (intonation) had a diminishing effect on repetition suppression in these areas (fig 2 c, d). Repetition suppression was reduced most significantly in the continuously changing pitch modulation (fig 2 e, f)**.**

Conclusions: To our knowledge, this is the first study, which demonstrated repetition priming in auditory related brain areas in response to repetitive auditory presentation of lists of words. The demonstration of reduced extent of repetition priming by modifying the prosodic feature of the pitch of words implies also that perceptual modulations of the pitch contour of spoken words effects their neural processing in a modality specific way.

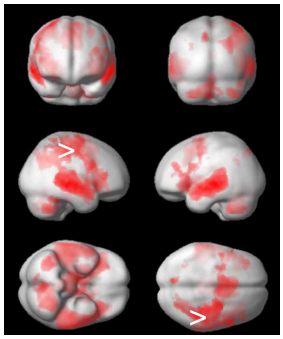

Figure 1. Activation maps (> left motor area pointing forward).

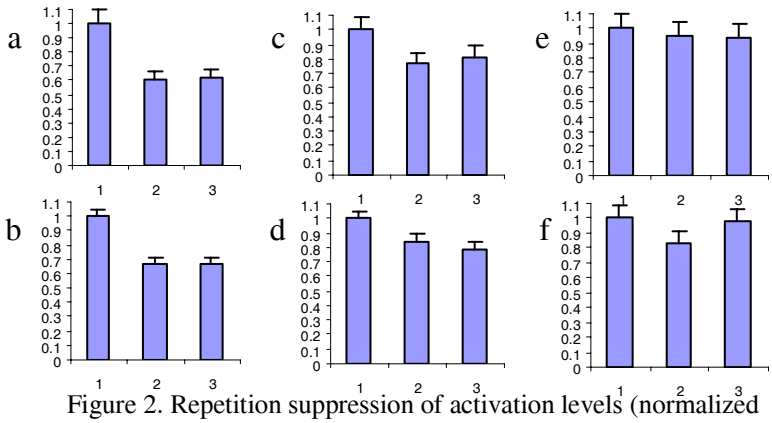

Figure 2. Repetition suppression of activation levels (normalized units) in three consecutive blocks as described in the text.

References: 1. Dehaene, S. et al. (2001), *Nature Neuroscience*, 4, 752-758.
2. Badgaiyan, R. D., Schacter, D. L., & Alpert, N. M. (1999), *Journal of Cognitive Neuroscience*, 11, 337-348.