



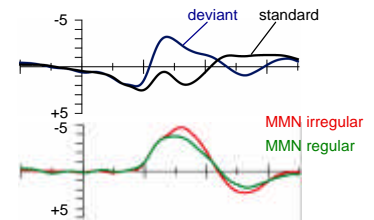
# Mismatch-Negativity and the effect of stimulus predictability. An fMRI-Study.

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## Background

- Mismatch-Negativity (MMN) is a component of auditory event-related potentials (ERP).
- MMN is elicited by infrequent deviant tones in a series of frequent tones: SSSDSSSS.
- MMN reflects automatic auditory change detection.
- MMN-generators in the vicinity of the auditory cortex are well established, while the existence and function of prefrontal generators remains unclear.

**Aim:** Presuming that temporal cortices subservice early change detection and frontal areas monitor stimulus expectations, we investigated whether a modulation of deviance predictability modulates frontal MMN-sources.



## Methods

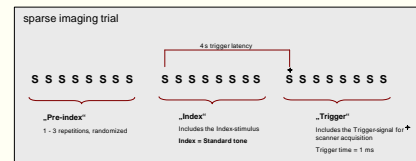
Nineteen healthy subjects (mean age 26.9 ± 6,3; 9 male) were scanned with sparse fMRI (Siemens 1.5T, TR 1.75 sec, TE 54ms, FoV 23cm, 64x64 voxel, 18 slices, 5.5mm, 5% distance factor, sparse MRI trigger delay 4s). While watching a silent movie, subjects were presented two vowel-like stimuli (80ms duration, SOA 500ms, „i“ F0=232Hz, F1=430Hz, F2=2840Hz, „u“ F0=232Hz, F1=470Hz, F2=1260Hz, Presentation, Neurobehavioral Systems Inc.). We compared 4 stimulus conditions: standards only (STD), STD with regular predictable deviants (MMNreg, 12%), STD with irregular deviants (MMNirreg, 12%) and a QUIET baseline condition. Each fMRI session consisted of 3 runs of 20 min each (table 1). Random-effects analyses over 54 images per condition were done using SPM2. Activations were analysed using the following contrasts: STD>QUIET, MMNreg>STD, MMNirreg>STD and the direct comparison of MMNirreg>MMNreg.

## Table 1: Design

Conditions:			
STD	standards only	SSSSSSSS	SSSSSSSS SSSSSSSSS
MMNreg	standard + deviant regular (12%)	SSSDSSSS	SSSDSSSS SSSSDSSSS
MMNirreg	standard + deviant irregular (12%)	SSDSSSSS	DSSSSSSS SSSSSSSS
QUIET	silent baseline condition	QQQQQQQQ	QQQQQQQQ QQQQQQQQ

**Design:**  
1 session = 3 runs (20 min each)  
1 run = 8 sequences (4 conditions x 2)  
1 sequence = 10 trials  
1 trial = 3 to 5 x 8 stimuli = 1 volume

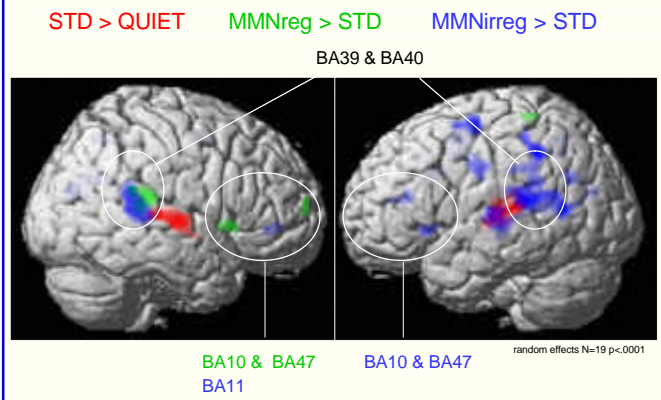
control for auditory stimulus effects: standard „i“-like / standard „u“-like sequences and runs randomized  
first trial in each sequence discarded: 54 Volumes / condition



## Results

Compared to the STD>Quiet contrast, in both MMN contrasts the temporal activation shifted to a more posterior position at the temporoparietal junction (BA39 and 40, fig.1). In the MMNreg>STD contrast (fig. 1, green) this activation was right lateralized. Additional activation was found in right frontal BA47, in the left somatosensory cortex (BA2/3) and in the cingulate gyrus (BA23 and 30; fig. 2a). The MMNirreg>STD contrast (fig. 1, blue) was associated with a broader left-sided BA39 and BA 40 activation. Further activations were found in left cingulate gyrus (BA24 and 32; fig. 2b) and left motor (BA4) and premotor (BA6) areas. Left prefrontal activation was found in BA10 and BA47. In the direct comparison of irregular > regular deviance conditions the temporoparietal activations emerged as statistically significant (fig. 3).

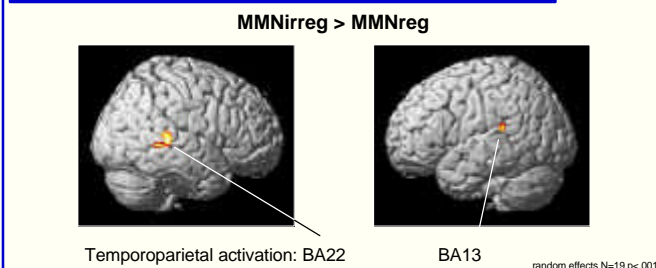
## Figure 1: Results



## Conclusion

Although enhanced prefrontal activation was found in the MMNirreg>STD contrast, in the direct comparison of both MMN conditions we found temporoparietal junction activation to be related to stimulus predictability. The use of the sparse-imaging method allows the comparison of MMN conditions with simple auditory stimulation. This yielded only a small activation overlap indicating a separation of deviance detection and primary auditory processing.

## Figure 3: Comparison of regular > irregular deviance



## Figure 2: Cingulate activation results

