COUNTING CHANGES IN COMPLEX ACOUSTIC ENVIRONMENTS.

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BACKGROUND

WHAT IS AN NATURAL AUDITORY TEXTURE?

Natural sound (e.g. wind or rain), that could be characterized on the statistical level (Boubenec et al., 2016; Kelly & O'Connell, 2013) and, although having variable spectro-temporal profile, can be easily classified by human (McDermott & Simoncelli, 2011).

CHANGE DETECTION

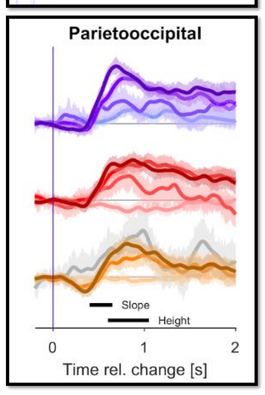
During the change detection tasks, textures evoke late parieto-occipital (PO) potential (related to: O'Connell et al., 2012) that scales with the amount of evidence given (Boubenec et al., 2017).

Longer sampling time was found associated with its increasing slope and amplitude. PO activity depends also on the level of active processing (Gorska et al., 2018).

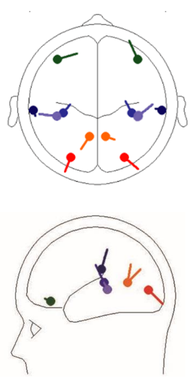
ERP analysis

MC – mixing coefficient

3s	0	0.15	0.3	0.6
1.6s	0	0.15	0.3	0.6
0.75s	0	0.15	0.3	0.6



Source analysis



From Gorska et al., 2018.

OUR APPROACH:

to verify change detection process during active engagement in counting task, by investigating the occurrence and the characteristics of **late parieto-occipital (PO) potential**

METHODS

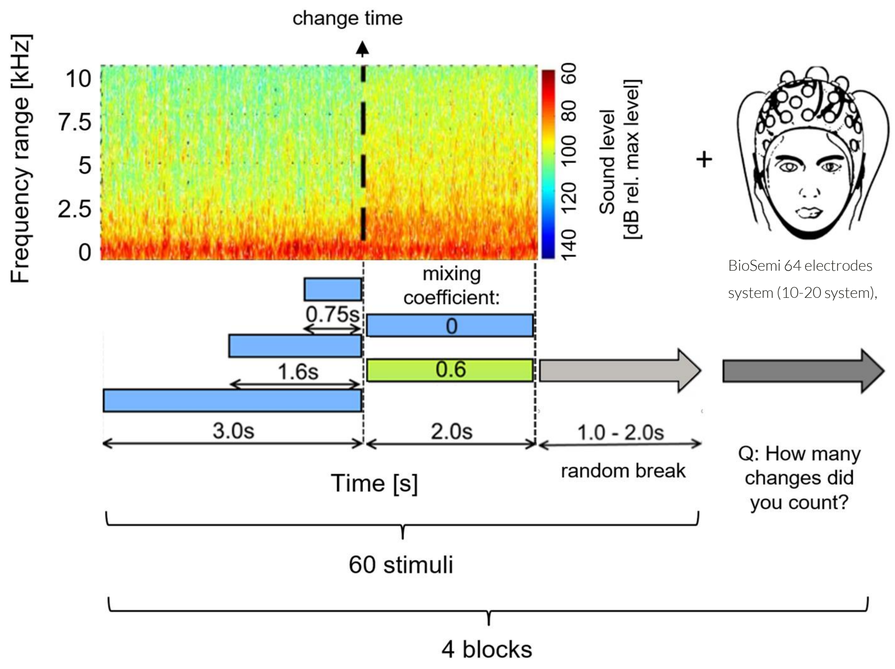
Participants:

13 healthy volunteers (mean age 27.2 SD 5.3; 8 females, higher education). All of them did not reported any known hearing problem.

Stimuli:

240 natural auditory textures stimuli with slightly different statistics; half of them changed their statistics (e.g. from rain to bubbles) at the random time (0.75s, 1.6s or 3.0s)

Procedure:



Data analysis:

Preprocessing: downsampling to 512Hz, average reference, artifact rejection (amplitude limits +/- 200μV, maximal voltage step 250μV/ms), 0.1 Hz high-pass to 40 Hz low-pass filters,

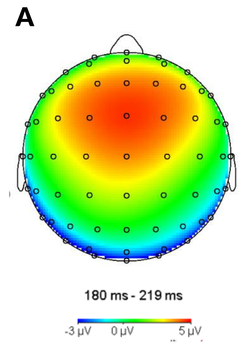
Epochs segmentation :

- **relative to stimulus onset:** -500 to 2000 ms (baseline -200 to 0 ms) from 'Cz', 'C1', 'C2' channels;
- **relative to change:** -200 ms to 2000 ms (baseline -200 to 0 ms) from 'Pz' and 'POz' channels.

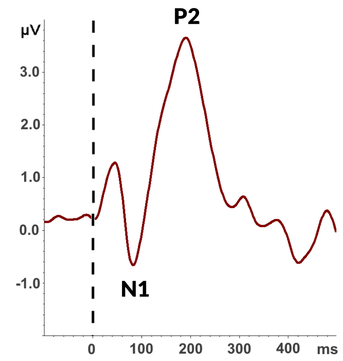
The analysis was performed in Brain Vision Analyzer 2 (Brain Products, Gilching, DE)

RESULTS

A



B

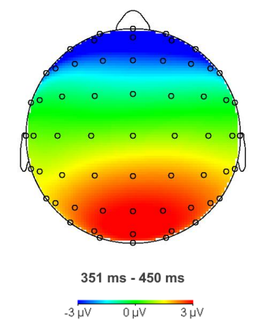


ONSET ERP

A. The scalp distribution of the P2 component (180-219ms) is centered with a slight asymmetry towards the front. Data were averaged over all stimuli.

B. An onset of an auditory stimulus creates classical complex, with a negative component (N1, peak at 82 ms) followed by a positive component (P2, peak at191 ms).

C



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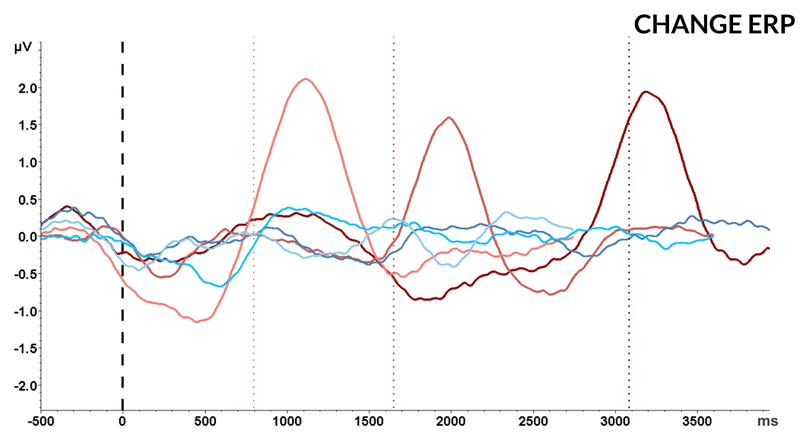

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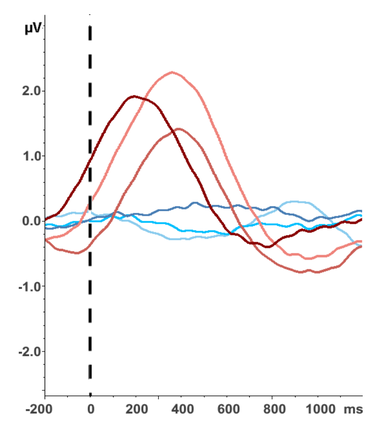

CT	CHANGE	NO-CHANGE
3.00s		
1.60s		
0.75s		

C T – change time

Table. PO potential amplitude and delay in different change-time and change/no-change conditions.

	0.75s	1.60s	3.00s	0.75s	1.60s	3.00s
AMPLITUDE [μV]	0.05	0.4	0.1	2.2	1.6	2.0
DELAY [ms]	750	1000	900	1100	2000	3200

C. The scalp distribution of the parieto-occipital potential (351 - 450 ms the change). Data were averaged over all stimuli from 0.75s change condition.

D. Parieto-occipital electrodes aligned to stimulus onset. Change in statistics leads to premature ERP with the greater amplitude comparing to trials where there was no change.

E. Parieto-occipital electrodes aligned to change in statistics. The amplitude and slope of the PO potential varies for different change times; amplitude is the greatest for 0.75s, lower for 3.0s and the lowest for 1.6s, while the 3.0s condition starts faster, 0.75s later and the 1.6s last.

DISCUSSION

- The amplitude of the PO potential tends to reversely scale with the time the texture was sampled.
- The increase in cognitive load and the time of rote rehearsal could cause the attenuation of the response for the longest change times .
- Subject could form expectation of maximal sound duration and consequently expect more the change that occur later than sooner (as in Boubenec et al., 2017) and moreover of the time of the change as the multiple of the most common CTs, what was reflected by a continued accumulation of evidence even before the change.
- The current paradigm served as one of the tests of change detection in naturalistic stimuli towards the method for diagnosing patients with disorders of consciousness (PDOC)

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