Early brain processing of pitch - height versus chroma

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Introduction

- Pitch is frequently described as two-dimensional:

Pitch height

Pitch chroma

- Is pitch chroma processed early and automatically in the human brain?
- Mismatch Negativity (MMN) -

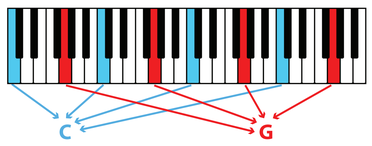
  an ERP (EEG) component indexing automatic detection of deviation from auditory regularity

Methods

- 27 musicians, EEG experiment:

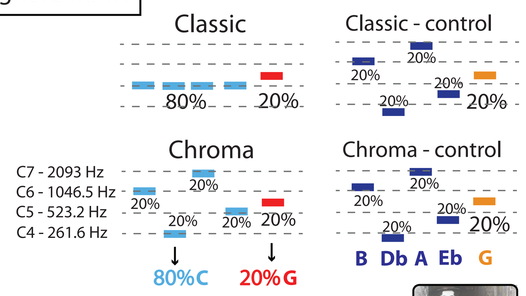
Ear training

Discriminating pure tones across 4 octaves based on pitch chroma:



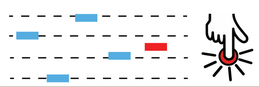
'Ignore' MMN

4 MMN block types:



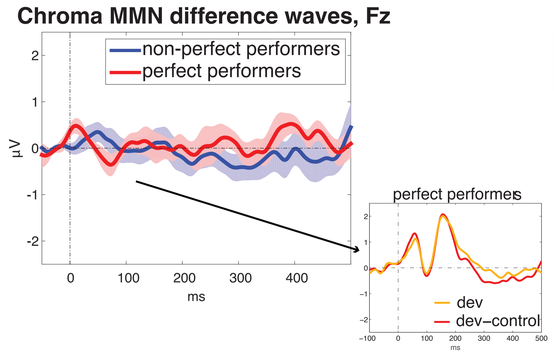
... while viewing a silent film

'Attend' block

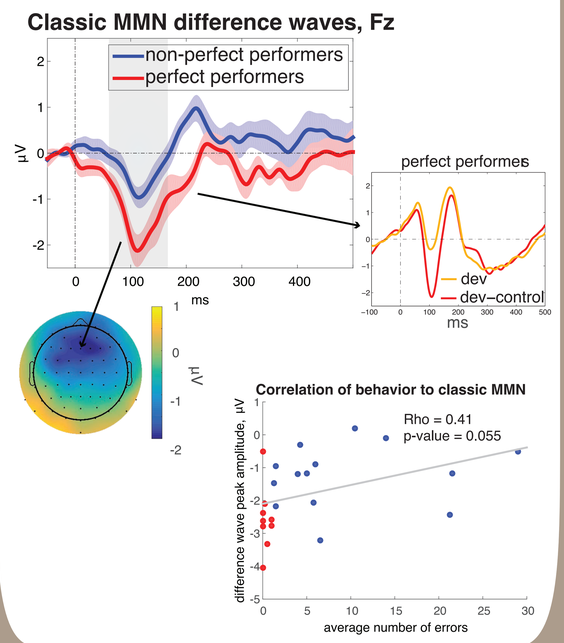


Results

- No chroma-related MMN neither in good nor bad performers.



- Classic MMN magnitude correlates to performance in the pitch chroma discrimination task.



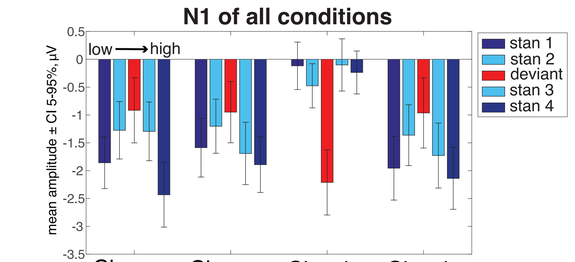
Results

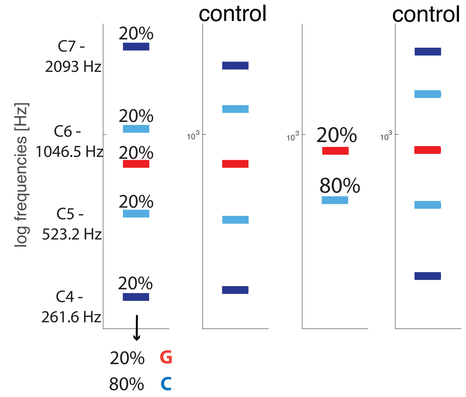
- N1 adaptation is based on distance from the mean

Repeated measures one-way ANOVA

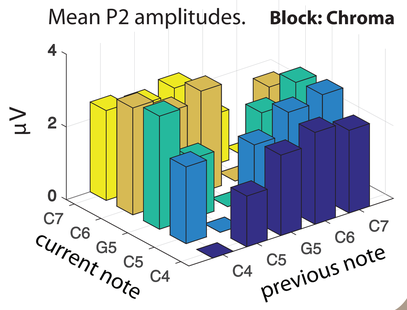
standard far from the mean
standard close to the mean
deviant

p<<<0.01 highly significant in all block types



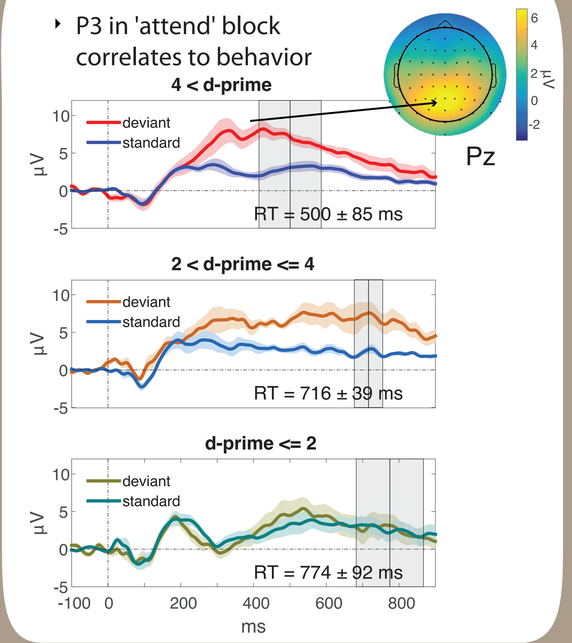


- P2 adaptation is significantly modulated by distance from last note



Results

- P3 in 'attend' block correlates to behavior



Conclusion

Pitch height -
proceesed automatically and pre-attentively

Pitch chroma -
later processing, requires attention

- Discriminating pitch chroma of pure tones can be learned, but it is not implemented in the brain automatically and pre-attentively, might require higher cognitive processes.
- Early pitch processing includes representation of distance from previous tones, on several timescales. (N1 global, P2 transient)