23.323

Increased alpha band activity indexes inhibitory competition across a border during figure assignment

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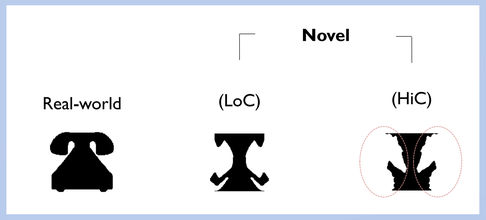
Background

Prior research shows that increased activity in the alpha band of the EEG may index inhibition of competing information when covert attention is directed to one hemifield and the distracting stimulus is in the other.[1,2,3] Here we tested whether increased alpha activity indexes inhibitory competition for figural status.

Question

Can alpha-band power index the degree of competition for figural status?

- Across a single border
- In one hemifield
- No attention cue/no delay



- Low-competition (LoC) = novel silhouettes with novel objects on the groundside.
- High-competition (HiC) = novel silhouettes with meaningful objects on groundside.

  Inhibitory competition between potential objects on opposite sides of the borders; loser is suppressed[4].
- More cross-border competition in HiC vs LoC [5].
- HiC and LoC equated on low-level features [6].

  Symmetry, convexity luminance, area, contour length.

Apparatus & Methods

64 channel EEG

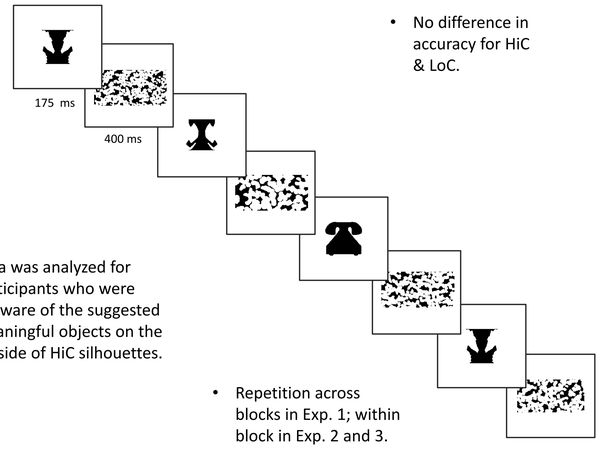
Wavelet-based time/frequency analysis (complex Morlet wavelets, $\sigma_t = f/5$, $\sigma_f = (2*\pi*\sigma_t)^{-1}$

Results normalized to average over 200 ms pre-stimulus baseline on an individual frequency basis.

Between-condition differences assessed via permutation statistics with cluster-based corrections of multiple comparisons ($p < 0.05$, 20,000 perms).

Task & Design

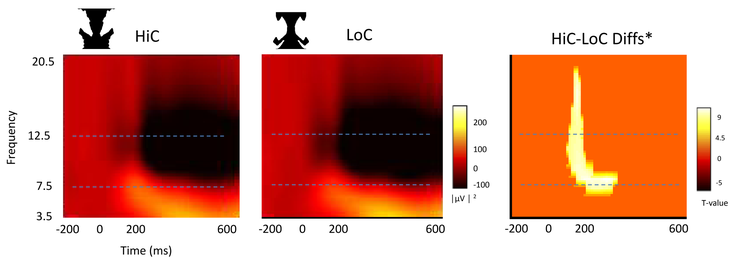
Task: real-world/novel categorization



- No difference in accuracy for HiC & LoC.
- Data was analyzed for participants who were unaware of the suggested meaningful objects on the outside of HiC silhouettes.
- Repetition across blocks in Exp. 1; within block in Exp. 2 and 3.

Experiment 1

4 Block design: Repetition across blocks (n = 49)



- Increased power in alpha range (7.5 – 12.5 Hz) for HiC vs LoC in first 200 ms. Also in high theta (~6.5 Hz) and low beta (~13 Hz +) ranges.

HiC and LoC equated → only difference is amount of competition.

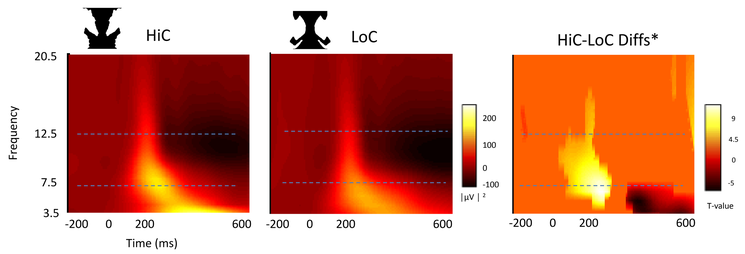
Alpha-band power was greater when there was more competition for figural status across a single border.

In one hemifield; no attention pre-cue; and no delay.

Electrode: PO4

Experiment 2: Replicate with shorter lag?

2x repeat, 18-21 intervening items (n = 24)



- Increased power in alpha range (7.5 – 12.5 Hz) for HiC vs LoC in first 200 ms. Also in high theta and low beta (~13 Hz +) ranges.
- Replicates Exp. 1 with a shorter lag.
- No change in alpha with repetition for HiC or LoC.

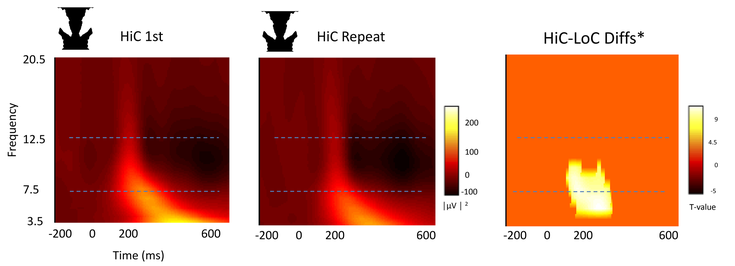
Alpha-band power was greater when there was more competition for figural status across a single border: in one hemifield; no attention pre-cue; no delay.

Electrodes: POZ, O1, Oz, O2

Experiment 3: Replicate with even shorter lag?

Short-lag : 2x repeats, 4-7 intervening items (n = 21)

Results: HiC alpha power not greater than LoC



- Alpha higher for 1st than 2nd presentation of HiC. Increased theta (~4 – 7.5 Hz)

Suppression of the suggested familiar object on first presentation was preserved and reduced competition on the second presentation.

Suppression can last over at least 4 intervening items (~10 sec).

Electrodes: POZ, O1, Oz, O2

Conclusions

Alpha-band power was greater when there was more competition for figural status across a border.

Exp 1 & 2: HiC > LoC

Exp 3: HiC 1st > HiC 2nd

- First demonstration that alpha-power indexes inhibitory competition for figural status.
- These results show that alpha can index competition while it's underway.

  In one hemifield.

How long does suppression of a competing object last?

- Previous RT evidence: For at least several hundred milliseconds.[5]

  Indirect measure of suppression.

  Behavior was multidetermined.
- Experiment 3 extends this estimate to ~10 seconds.

  Direct measure of suppression.

  Indexing amount of competition.
- fMRI evidence (see poster: 23.319).[7]

[1] Worden, Foxe, Wang, Simpson (2000). *J. Neuro*, 20, 1-6.
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[4] Peterson & Skow (2008). *J of Exp. Psych*, 34(2), 251-267.
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[6] Trujillo, Allen, Schnyder & Peterson (2010). *J of Vision*, 10(2).
[7] Cacciamani, Scalf & Peterson (2014). *VSS 2014.* Poster: 23.319.

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