Sustained gamma-band EEG activity in response to emotional information in depression and schizophrenia

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ABSTRACT

- Background: Sustained emotional reactivity is a hallmark of depression. Sustained high frequency EEG (20-50Hz) following presentation of emotional information could suggest whether such reactivity reflects elaborative binding of semantic features.
- Method: EEG data in the 10 seconds following presentation of emotional stimuli in healthy individuals as well as individuals with depression and schizophrenia was subjected to wavelet decomposition.
- Results: Depressed individuals displayed increased and sustained widespread high-frequency EEG in response to emotional information relative to healthy individuals and individuals with schizophrenia.
- Conclusion: Sustained emotional reactivity in depression could reflect sustained elaborative semantic processing as well as underlying ruminative processes.

INTRODUCTION

- Depression is characterized by elaborative semantic processing:
  - Memory biases for negative information (Harris, 1988; Mast et al., 1992 meta-analysis)
  - Interpretation of information as negative (Brandt & Abrahamson, 1983; Norman et al., 1983)

- Sustained brain reactivity to emotional information has also been observed in depressed individuals via ERPs, pupil dilation, and fMRI (Nacko et al., 2005; Siegle et al., 2002; 2004)
- It is unclear whether observed sustained brain activity to emotional information reflects elaborative semantic processing.
- High frequency EEG (20-50 Hz), particularly stimulus-induced gamma-band EEG (~40 Hz) has been associated with feature binding (Tallon-Baudry & Bertrand, 1999).
- Thus, gamma-band EEG may be a useful index of the extent to which brain activity following emotional stimulation reflects semantic processing in depression.

METHODS

Procedure
- Day 1 SCID interview, Cognitive screen
- Day 2: EEG assessment

- Participants

<table>
<thead>
<tr>
<th></th>
<th>Healthy Control</th>
<th>Depression</th>
<th>Schizophrenia</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>24</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td># male</td>
<td>12</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td># Caucasian</td>
<td>20</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Age Range</td>
<td>18-53</td>
<td>21-58</td>
<td>33-50</td>
</tr>
<tr>
<td>Age (M/SD)</td>
<td>30.2 (11.4)</td>
<td>43.1 (14.2)</td>
<td>41.5 (5.6)</td>
</tr>
<tr>
<td>BDI at testing</td>
<td>2.8 (2.9)</td>
<td>22.8 (8.0)</td>
<td>13.2 (8.1)</td>
</tr>
</tbody>
</table>

- EEG Data Collection:
  - 20 channel EEG data collection using a preconfigured Physiomix cap referenced to nose with forehead as ground. Electrodes medial to the left eye (above, below) and at the outer canthi of both eyes measured eye movements. Data were recorded at 250 Hz (1 samp/4 ms), 0.2-100 Hz bandpass, via Sensorium amplifiers. Impedances < 30 kΩ.
  - Data were collected using EEGSYS (Hartwell, 1998).

- Preprocessing:
  - Blinks, eye movements, and other artifacts (voltage exceeding ± 150 µV) were corrected by applying Gratton et al’s (1983) procedure (code by Miller et al) using the FOG data. Remaining regions of sustained blinks were corrected using linear interpolation (effectively removing frequency domain information associated with large blinks).

- Task:
  - Emotional Valence Identification of Words

- Grand mean ERP data to the task were consistent with sustained engagement throughout trials.

- Stimuli included 240 words from the ANEW (Bradley & Lang, 1999) set balanced for word length, frequency, normed affective valence (<3 = negative, 4-6 = neutral, >7 = positive), and arousal within valence.

- Wavelet decomposition allows identification of these oscillations at each sampled time.

- Sustained gamma-band EEG (~40 Hz) has been associated with feature binding (Tallon-Baudry & Bertrand, 1999).
- Gamma band EEG allows measurement of activity throughout the brain over time.

- EEG allows measurement of activity throughout the brain over time.

- Depression
- Schizophrenia

- Task:
  - What’s the emotion?

- Gamma band EEG represents oscillations at 35-45 Hz. Wavelet decomposition allows identification of these oscillations at each sampled time.

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RESULTS

Non-Baseline Corrected data

Fz – all groups, all valences, all frequencies

1st 2 seconds after stimulus onset

Positive
Negative
Neutral

Depressed
Control
Schizophrenia

Baseline Corrected data

Fz – all groups, all valences, all frequencies

1st 2 seconds after stimulus onset

Positive
Negative
Neutral

Depressed
Control
Schizophrenia

What to notice in that figure

The nonbaseline corrected data has lots of reds and yellows above 15Hz only in the depressed group… depressed individuals displayed significantly more high frequency activity to all valences throughout trials than other groups.

The baseline-corrected data has lots of reds above 15Hz only in the depressed group. Depressed individuals displayed significantly more high frequency activity to negative words 4-6 seconds following the beginning of trials.

DISCUSSION

Depressed individuals displayed sustained and increased gamma band (35-45Hz) EEG throughout the task, and particularly increased stimulus-related gamma band EEG to negative words compared to control participants and individuals with schizophrenia.

These data are consistent with the idea that depressed individuals engaged in sustained semantic processing of emotional information in the context of the task.

References


References


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