

# Creative thinking in computerized Alternative Uses Task – an EEG pilot study



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## Introduction

### Creativity:

- Creativity as an elusive concept and an ill-defined problem
- Guilford as the first to propose creativity studies and evaluation using a pencil-and-paper psychometric approach<sup>1</sup>
- Divergent thinking as a reliable indicator of creative potential<sup>2</sup>
- Novelty (or originality) as a crucial constituent and metric of creativity; measured by statistical originality<sup>3</sup>
- More responses = more novel responses and higher average novelty score<sup>3</sup>
- Bounded Ideation Theory: positive s-curve ideation function; no. of good ideas increases with better understanding of the problem and decreases as participants get exhausted<sup>4</sup>

### EEG studies:

- Increased frontal alpha power and synchrony, temporal and parietal alpha synchrony<sup>5</sup>

### Complexity studies

- No creativity studies applying complexity analysis up to date

## Aim of the Study/Hypotheses

- Investigate the neuronal correlates of creative processes
- Replicate previous findings in power spectra analysis
- Expect higher complexity in more creative individuals

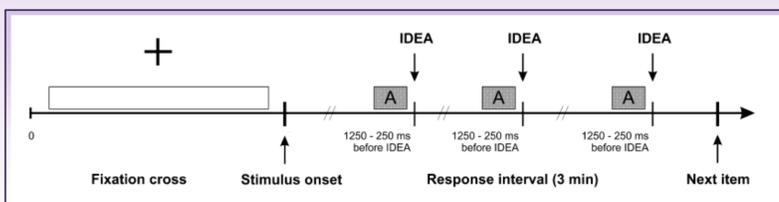
## Materials and Methods

### Participants:

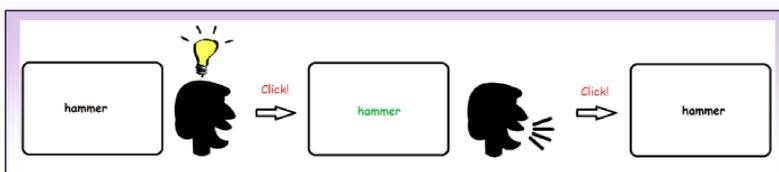
- Creativity task: 15 (8 F, 53.33%) , age 22-36 (M = 26.00, SD = 3.87)
- EEG pilot study: 11 (6 F, 54.55%) , age 22-36 (M = 25.91, SD = 4.13)

### Alternative Uses Task:

- A computerized version of Guilford's Alternative Uses Task (AUT)<sup>6</sup>
- „List as many alternative uses for the item presented as you can think of in 3 minutes”
- 5 items (umbrella, shoe, soap, pen, brick)



- Idea button to eliminate speech artifacts from EEG recordings
- Analyzed epochs of -1250 to -250 ms prior to the reported idea



- Responses evaluated on originality, fluency, flexibility and elaboration<sup>3</sup>

## Signal analysis:

1. **Spectral analysis:** power spectrum in separate frequency bands
2. **Nonlinear analysis:** fractal dimension for complexity measurements
- **Higuchi's fractal dimension (HFD)** measures the complexity of time series<sup>7</sup>
- HFD of the EEG signal estimates brain function complexity dynamics, due to the particular sensitivity to signal fluctuations exhibited by this method

## Results

### 1. COMPLEXITY (HFD)

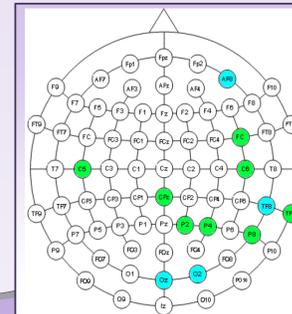


Fig.1. Difference between more and less creative (NO. OF IDEAS) individuals in signal COMPLEXITY (HFD)

### 2. POWER SPECTRUM ANALYSIS (FFT)

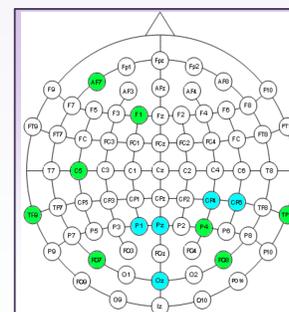


Fig.1. Difference between more and less creative (NO. OF IDEAS) individuals in GAMMA band power

- Green-marked electrodes:  $p < 0.05$
- Blue-marked electrodes:  $p < 0.1$

Fig.1. Difference between more and less creative (ORIGINALITY) individuals in signal COMPLEXITY (HFD)

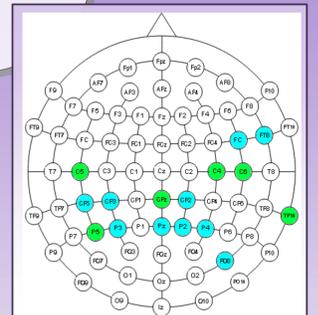
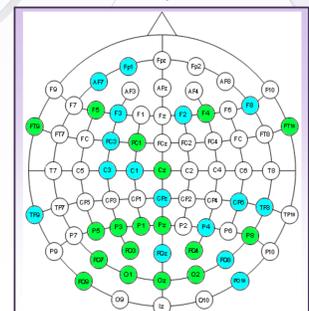


Fig.1. Difference between more and less creative (NO. OF IDEAS) individuals in DELTA band power



## Conclusions

- More creative individuals (both concerning originality and number of ideas) exhibit higher complexity and therefore lower regularity of the EEG signal obtained during divergent thinking task. This possibly depicts higher complexity of neuronal processes involved in creative thinking.
- Moreover, higher power in gamma and delta bands of the spectrum were present in the more creative individuals, who produced more ideas.
- No difference in alpha band power was found between the groups.

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