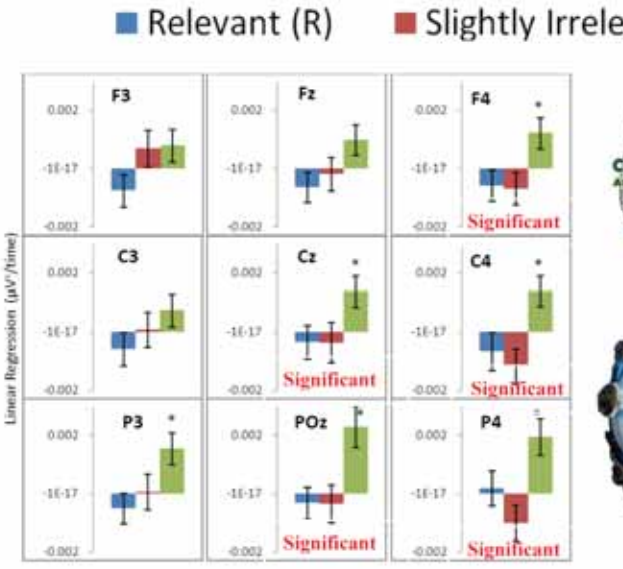
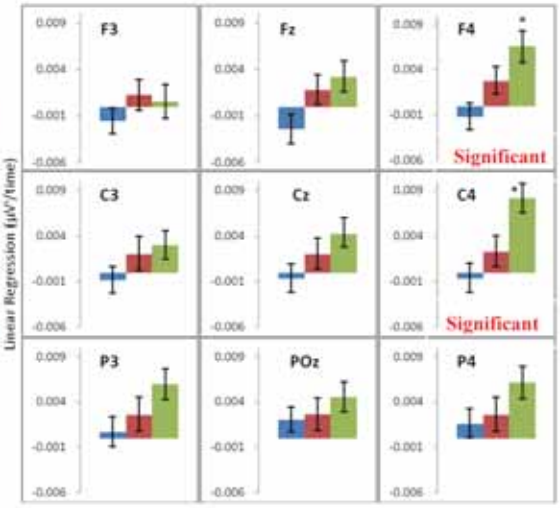
Enhancement of Intelligence Analysts' Extraction of Text-Based Content

A closed-loop analysis system was developed to use intelligence analysts' neurophysiology to auto-extract text snippets relevant to the current analysis goal during processing textual data and associated decision making. The combination of EEG from a wireless headset and eye gaze from an eye tracker were used to identify and track sub-conscious elements of interest to ensure all relevant information was taken into consideration, while still allowing the analyst to also manually extract items they perceive as relevant. This approach was intended to reduce the effects of analyst bias and inattention and provides a faster, more accurate extraction of evidence.

The system was validated in study of 27 healthy subjects. Participants were first shown a short background story that provided the analysis scenario and a related one-sentence proposition (analysis question), and were then asked to view a series of 30 sentences to determine their relevance to the provided proposition. Ten of the sentences were relevant to the analysis question, 10 were totally irrelevant and 10 were irrelevant but contained key words found in the study topic. The figures below marked as "significant" identify the areas of the brain where the sub-conscious elements of interest can be recognized with fast theta and slow alpha EEG frequency bands.



Fast Theta band (5-7 Hz) beginning at time of sentence presentation; ending at keyed response.



Slow Alpha band (8-10 Hz) beginning at sentence presentation; ended one second later, regardless of response.

The amount of EEG theta activity, adjusted to account for individual differences in theta generation, was linearly related to the assimilation of information within the reader's mental construct. When a reader began to read a sentence theta levels were high. As the reading of the sentence continued, if the information was consistent with the reader's belief system, theta levels gradually dropped. If the information was inconsistent or conflicted with the reader's mental model, theta values increased sharply. The results suggest that only EEG from the right hemisphere of the brain is needed for this text-based application. This study demonstrates how the number of sensors needed for a particular application can be reduced to improve the trade-off between increased speed and accuracy vs. user inconvenience when wide deployment is considered. Application of the automated linear theta scale has the potential to allow researchers to tailor content for desired outcomes.

Behneman, A., Kintz, N. et al. (2009). Enhancing Text-Based Analysis Using Neurophysiological Measures. 13th International Conference on Human-Computer Interaction, San Diego, CA.