Brain signals for susceptibility and distractibility

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Susceptibility for information is quite variable over time and this has implications for the timing of the delivery of relevant information. The ability to control interference from irrelevant information (the reverse of distractibility) is similarly important in such settings. Fascinating strides have recently been made in deciphering the brain signals (EEG) that control and predict such cognitive competences. For example, the presence of oscillating signals from the more controlling, frontal part of the human cortex, to the visual brain in the back of the head, predicts the speed of detection of a visual signal (Mazaheri et al., 2010), and also the probability that on-going actions are interrupted when necessary (Mazaheri et al., 2009). EEG parameters have further been used to predict whether an infrequent target interspersed within a stream of non-target visual patterns would be detected or not. The predictive capacity was apparent already at 20 seconds before the presentation of the target (O'Connell et al., 2009). Another example concerns safety during car driving. Brain-signal technology for recording and on-line analysis of EEG (see below) has developed so far that it can be used for continuously monitoring brain state to detect lapses in vigilance and in sensitivity to relevant external signals or information. Studies probing the brain state during as long as 4 hours of continuous highway driving have revealed clear monotonous reductions in alertness, even though subjects reported that they became more alert towards the end of the 4-hour period (Schmidt et al., 2009). In our own work we have developed methods to assess dual-task performance during driving along with EEG measures of susceptibility to unexpected but potentially relevant events (Wester et al., 2008, 2010).

Importantly, these relations between brain signals and cognitive competences are revealed by either comparing different individuals, or moment-to-moment fluctuations within individuals, or differences in state (e.g., drug-induced) within individuals. Hence, these brain signals can be used to trace the moment-to moment-fluctuations in susceptibility and distractibility.

Summarizing, cognitive functions that are important for everyday healthy life are controlled, and can be predicted from, seconds or minutes of preceding brain signals. This presentation highlights recent developments in this particular field, discusses the major methodological principles, and provides a first glimpse on the applicability in real-life situations.

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