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Observed Changes in the Visual Oddball Event-Related Potential in a 10-Session, Longitudinal Study

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Introduction: The visual oddball paradigm is used in psychophysiological research [1] and brain-computer interface paradigms [2] to elicit the P3b event-related potential (ERP). Generally, test-retest reliability of the P3b is thought to be high over repeated sessions [3-5]. However, there are few studies that have observed the elicitation of the P3b over many repeated sessions over several months. In this study, we elicited the P3b using a standard visual oddball paradigm [6] in 10 sessions over approximately 3-4 months and observed changes in both P3b morphology as well as ERP features (i.e.. amplitude, latency) commonly derived from the P3b morphology over sessions.

Material, Methods and Results: 30 participants completed 400 trials of the visual oddball task, with a 4:1 oddball to standard stimulus ratio, in each of 10 sessions, held on the same day and at the same time each week, over approximately 3-4 months. Electroencephalography (EEG) data were collection using the BioSemi ActiveTwo (BioSemi, Amsterdam, The Netherlands) using a 2048 Hz sampling rate at 64 channels locations. In addition to group-averaged oddball, standard, and difference-wave ERPs, amplitude (as positive mean amplitude; Fig. 1) and latency (as 50% positive area latency; not shown) [7] of the P3b were calculated at the group level for each of the ten sessions, or days (D01 through D10), at Pz.

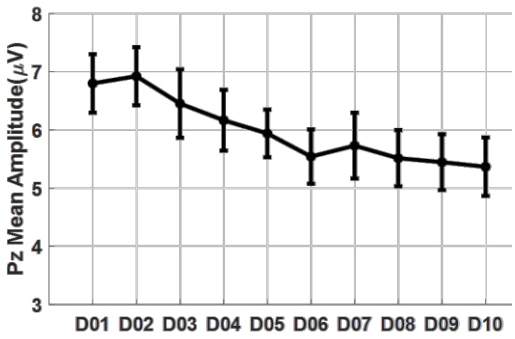

Figure 1: *P3b amplitude at Pz, averaged at the group-level (N = 30), for each of the ten sessions, or days (D01 through D10). Error bars are ±1 standard error of the mean (SEM).*

Conclusion: Test-retest reliability of the P3b should not be assumed in all situations given the clear, nearly monotonic changes over sessions observed in this longitudinal study (e.g., amplitude, Fig. 1). Although the factors leading to these changes need to be investigated in subsequent studies, and these data were collected open-loop, these results may have an impact on BCI decoder accuracy in long-term, daily use.

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