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Letter to the editor

Evaluating the quality of ERP measures across recording systems: a commentary on Debener et al. (2002)

To the Editor—A recent study in this journal (Debener et al., 2002) reported good internal consistencies (Cronbach's $\alpha > 0.8$) for prominent ERP components recorded with a 64-channel Geodesic Sensor Net (GSN). However, data were pooled across multiple sites, a strategy incongruous with the purpose of improving topographic information with dense-electrode arrays. We question the validity of their generalization 'that use of the GSN does not necessarily result in a lower signal-to-noise ratio,' which is based on the premise that these reliability analyses are sufficient estimates of ERP signal-to-noise ratios. This claim may be misleading without a thorough comparison of the quality of EEG/ERP measures obtained with new vs. established recording systems using various cognitive paradigms and/or populations. In a preliminary study (Kayser et al., 2000), we reported larger ERP amplitudes and better signal-to-noise ratios for conventional 30-channel electrocap compared to 128-channel GSN recordings. In this *direct* comparison of data for the same subjects and paradigm, well-established, although subtle, topographic effects were more robust for the electrocap system, yielding larger effect sizes of task-dependent hemispheric asymmetries. To maximize comparability, we intentionally avoided confounds resulting from an average reference derived from different electrode configurations, and compared only ERPs referenced to nose tip (a 'common average' is *not* a 'reference-free transformation'). Internal consistencies at individual, corresponding scalp locations were equally high for *both* EEG systems for prominent components, and comparable to those reported by Debener and coworkers. Although a very important statistical indicator of data quality, reliability is only one indirect estimate of ERP signal-to-noise properties, with additional constraints imposed by the underlying biophysiology. Identical ERP averages can be obtained from background EEG activity with markedly different noise distributions, provided the number of trials is large enough (central limit theorem) and the signal is stable over time (e.g. Möcks et al., 1988). However, the different noise characteristics are irreversibly lost and undetectable by reliability analyses.

References

Debener, S., Kranczioch, C., Herrmann, C.S., Engel, A.K., 2002. Auditory novelty oddball allows reliable distinction of top-down and bottom-up processes of attention. Int. J. Psychophysiol. 46 (1), 77–84.

Kayser, J., Tenke, C.E., Bhattacharya, N., Stuart, B.K, Hudson, J., Bruder, G.E., 2000. A direct comparison of Geodesic Sensor Net (128-channel) and conventional (30-channel) ERPs in tonal and phonetic oddball tasks. Psychophysiology 37, S17 [Paper and animations available at URL http://psychophysiology.cpmc.columbia.edu/DEA2000.html].

Möcks, J., Gasser, T., Köhler, W., 1988. Basic statistical parameters of event-related potentials. J. Psychophysiol. 2 (1), 61–70.

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