

The Potentially Deleterious Impact of Muscle Activity on Gamma Band Inferences

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Sir,
In an exciting study recently reported in *Neuropsychopharmacology*, Barr *et al* (2009) found that the application of high-frequency repetitive transcranial magnetic stimulation (TMS) amplified the gamma band (30–50 Hz) brain electrical activity associated with performance of an *n*-back working memory (WM) task.

As a precursor to the analyses of TMS effects, WM-related gamma activity was examined. Critically, gamma activity during the delay period showed a significant effect of load (2-back > 1-back > 0-back) in an *a priori* frontal cluster of electrodes (AF3/4, F3/4, F5/6, F1/2, Fz). This effect is consistent with observations made using hemodynamic techniques and intracranial measures of gamma activity (eg, Axmacher *et al*, 2008).

But are load-dependent changes in gamma activity actually generated in the brain or are they simply an artifact of changes in cranial muscle tension? It is clear that the facial muscles, in particular, are exquisitely sensitive to a variety of cognitive and affective processes, including cognitive load (Shackman *et al*, 2009). The electromyographic (EMG) activity generated by these muscles is present at virtually all frequencies, extending as low as 2 Hz, and can be detected across the entire scalp (Shackman *et al*, 2009).

Unfortunately, it is difficult to judge whether the load-dependent gamma band effects reported by Barr *et al* are myogenic because the key figures (Figures 3 and 4) only show TMS-induced changes in activity, rather than the simple effect of load. It also would have been helpful to know whether the activity at higher frequencies, which are presumably more sensitive to the EMG, exhibited a similar

dependence on load. Broadly similar concerns apply to earlier scalp-recorded electroencephalography studies that reported observing amplified gamma activity during the performance of WM tasks (eg, Haenschel *et al*, 2009; Tallon-Baudry *et al*, 1999).

DISCLOSURE

The authors declare no conflict of interest.

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