Modulation of the earliest visual evoked potential by attention: now you see it, now you don't

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ABSTRACT

Baumgartner and colleagues (this issue) report a replication of an ERP study by Kelly, Gomez-Ramirez, and Foxe (2008). Unlike the original authors, they failed to observe a significant modulation of the C1 by visuo-spatial attention. They conclude that initial afferent processing in V1 is impermeable to visuo-spatial attention. Although their study, like any replication effort, is valuable and important, there are some uncertainties at the methodological and statistical levels suggesting that the absence of evidence is not evidence of absence in the present case.

COMMENTARY

Baumgartner et al. are to be commended for their replication of an earlier ERP study by Kelly et al. (2008). Theirs is a valuable contribution to an ongoing debate in cognitive neuroscience (Slotnick, 2013), namely whether the C1 component, corresponding to the earliest deflection in human visual evoked potentials, is sensitive to attention or not. The authors report evidence against a modulation of the C1 by visuo-spatial attention using similar experimental and analytical approaches as the original study. They conclude that these findings support the "majority view", which assumes that modulations of early visual processing happen only after the C1 (i.e., during the P1 and N1, as replicated in their study). However, a closer look at their methods and results suggests that the evidence in favor of the null hypothesis may actually be limited in the present case, casting doubt on whether this is indeed a straightforward confirmation of the "majority view".

First, Baumgartner et al. introduced an important change compared to Kelly et al. (2008), thereby complicating direct comparisons between the two studies. Whereas Kelly et al. (2008) stimulated diagonally opposite locations in the upper and lower hemifield, Baumgartner et al. used locations symmetrical to the vertical meridian, and repeated this manipulation for the upper and lower visual hemifield in separate blocks. We surmise that this could have reduced C1 effects in the present study, a point which the authors themselves acknowledge.

Furthermore, a closer look at Figure 3 and the corresponding statistical result [see p.7; $F(1,16) = 2.24$, $p=0.15$ for effect of attention on the C1] shows C1 differences in the direction

suggested by the "minority view". While clearly below the standard $p<.05$ cutoff, these results do not provide conclusive evidence for rejecting the alternative hypothesis either (Wagenmakers, 2007). Indeed, the present discussion is a prime example of when a departure from standard hypothesis testing in favour of a Bayesian approach could help integrate divergent empirical findings. By sharing their data and analysis tools with the community, Baumgartner et al. have taken important steps in this direction. For example, it would be interesting to combine data from the two studies in an integrated statistical model.

Finally, Figure 7 shows large interindividual differences in C1 topographies and waveshapes, even after exclusion of participants not presenting a clear polarity reversal during the C1 interval. This mirrors our own experience, but the variability remaining after pre-selection of optimal stimulus and electrode locations should give us pause. One difference between studies that do or do not observe C1 modulations is that many of the former have relied on peak amplitude measurements, rather than mean amplitudes. While fraught with its own problems (see Luck, 2014), we would argue that peak amplitude can yield more sensitive assessments of a component such as the C1.

As noted by Baumgartner et al., small but significant top-down effects on the earliest stages of visual processing have been conclusively demonstrated in other species. It may require a concerted effort based on more advanced measurement and analysis methods to resolve whether these effects have been conserved in humans. In this context, rather than opposing two views in a black-and-white fashion, it might be more fruitful to systematically test methodological factors that favor or hinder attentional modulations of the C1 (see Rauss et al., 2011).

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