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Letters to the Editor

Methodological Concerns about an ERP Study of Emotional Responsivity: A Commentary on Carretié et al.

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In a recent event-related potential (ERP) study published in this journal, Carretié and colleagues concluded that a negative component, labeled N300, "is sensitive to the affective charge of visual stimuli" (Carretié, Iglesias, & Bardo, 1998, p. 381). While we concur that a "parietal emotional ERP component" reflects affective significance, we do not feel that this conclusion is supported by the data presented in this study. In particular, there appear to be logical inconsistencies in the data and experimental design as they were reported.

Carretié and colleagues presented and analyzed ERP data over a post-stimulus interval of 325 ms. This interval was clearly insufficient to measure time-locked brain activity to complex visual stimuli. The grand average waveforms presented in Figure 2 allow the identification of ERP components P1 (approximate latency 150 ms) and N1 (180 ms). In addition, depending on the particular stimulus category used in this study, P2 and N2 components can be identified as they vary in latency (250-300 ms) and amplitude. Although the rising phase of a prominent P3 component is evident following N2, it does not peak during the 325-ms post-stimulus interval. As pointed out by the authors themselves, ERP components P3 and positive slow wave have been reported to show greater amplitudes to emotional than neutral stimuli (e. g., Johnston, Miller, & Burleson, 1986; Kayser et al., 1997; Palomba, Angrilli, & Mini, 1997). The use of such an extremely short recording epoch does not allow the characterization of a late positive complex in this study.

The authors indicate that they used a covariance-based principal components analysis (PCA), in which the first four factors accounted for more than 90% of the total ERP variance. However, the Varimax rotated factor loadings presented in Figure 3 are problematic. The most glaring problem is that Factor 1 accounts for more than 75% of the overall ERP variance, but has a maximum loading (> 0.6) between 0 and 170 ms. The ERP averages shown in Figure 2 indicate that this component primarily characterizes the low amplitude (post-stimulus) baseline preceding P1. Since ERP variance represents the mean squared signal amplitude, extraction of this factor using a covariance matrix can only be possible if differences in the variance of the baseline are greater than the variance of the actual ERP. This possibility is unlikely, since the baselines shown in Figure 2 appear to be reasonable. A more likely possibility is that the factors were either extracted in a different manner than what is described in the methods section, such as using a correlation matrix or a nonstandard approach. In this regard, it should be noted that all four factor loadings: (1) include a substantial DC contribution of approximately one fourth of their peak amplitudes; (2) never invert in sign over their time course; and (3) have comparable maxima less than 1. As another inconsistency, the steep decrease in variance across these four factors (i. e., 76.6%, 7.5%, 6.0%, and 3.4%) is uncharacteristic for Varimax rotated data, and is more likely to reflect the percentage of variance explained for the unrotated factors. Unfortunately, the authors did not indicate which statistical program was used to perform the PCA, which could have helped to resolve these problems.

The meaning and importance of the reported PCA components remain unclear for several additional reasons. In interpreting the extracted factors, the authors rely solely on the peak latencies of the factor loadings to identify ERP components believed to relate to these factors. The PCA identifies variance across ERP waveforms (i. e., the cases) rather than merely peaks in ERP waveforms (e. g., Chapman & McCrary, 1995). To allow inferences about the correspondence between these four factors and conventionally defined ERP components, a critical evaluation of the topography of the factor scores is also required. While focusing on latency criteria, the authors erroneously equated their N300 component with a PCA component we identified as "P285" or early P3 (Kayser et al., 1997). However, the ERP time course and the lateral-parietal topography of the N300 component more closely matches our N2 component. Moreover, in accord with our N2 findings, a right-hemispheric N300 enhancement is visible in the ERP averages presented by the authors. Because of the difficulties inherent in the interpretation of PCA factors, a parallel analysis of conventionally defined ERP measures would have been useful to support component identification, and to address some of these concerns (e. g., Chapman & McCrary, 1995; Dien, 1998; Wood & McCarthy, 1984).

Besides these issues concerning data analysis, we question the suitability of the experimental procedure to study *emotional* processing of visual stimuli. Although the authors hint at "cognitive biasing risks," they employed a "distracting task … to prevent the subjects from easily making emotional vs. non emotional categorizations of the stimuli" (Carretié et al., 1998, p. 377). The selected task, i. e., matching the content of the two halves of a chimeric stimulus composite consisting of a color and an inverted black-and-white slide, enhanced cognitive operations at the expense of affective processing. Given this procedure, any ERP differences between the stimulus categories should be interpreted to reflect primarily cognitive effects that arise from the left/right side comparison of different visual stimuli (see Kayser et al., 1997, for a discussion of this problem). Unfortunately, the behavioral performance across stimulus categories was not reported. Furthermore, even though the composite stimuli were constructed from stimulus categories with affective significance (i. e., insects, babies, nudes, buildings) and differed in ratings of arousal and valence, these stimuli unquestionably differed also in other stimulus characteristics as well. Thus, for both reasons, it is difficult to unambiguously attribute any ERP differences to differences in emotional or affective value of the stimuli.

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