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Origins of substitution

Reply to Bachmann

In response to Professor Bachmann¹ concerning our article on visual masking², we address two major issues raised in that letter.

(1) *We failed to note Bachmann's thalamic facilitation theory in our article. What is more, our re-entry-based model of object substitution does not recognize the importance of nonspecific thalamic modulation in establishing the contents of conscious experience.*

Bachmann's theory and ours address related, but different, domains. In our view, Bachmann's theory has more to say about the role played by nonspecific thalamic modulation in conscious experience than it does about the nature

of the specific cortical representations assumed to form the contents of consciousness. By contrast, our object-substitution theory is a framework for studying specific cortical representations, but it stops short of being a theory of consciousness.

Object substitution proposes that masking occurs while objects are in the process of being formed and does not therefore depend on the processes of consciousness *per se*. To put it in Bachmann's own terms (Ref. 3, p. 174), our theory says more about how objects materialize on the stage of consciousness than about who raises the curtain or what the audience sees once the curtain is raised. From this perspective, Bachmann's theory takes object formation as a given, and singles out non-specific thalamic signals as the curtain-raiser.

We agree with Professor Bachmann that there is more to visual perception than is encompassed by our model of masking and attention. Notably, our model is limited to an account of how the specific cortical modules that are on the stage of Bachmann's theatre might be doing their job. That is why we did not address ourselves to the larger questions of what neural activity may be necessary or sufficient for conscious experience. As Bachmann points out, our two views could very well be complementary, each requiring the other for a complete account of masking at neurophysiological, behavioural and phenomenological levels. We look forward to future work that tries to integrate these ideas.

(2) *We failed to credit ideas that have been expressed in writing by Bachmann and failed to cite Cohene and Bechtoldt⁴, who also reported masking by common onset.*

Our article was intended as an update on visual masking, not a comprehensive review of past work. The sentences quoted by Professor Bachmann were taken from the first paragraph in the section 'Nagging problems for the standard view' and the last section on the role of attention. They describe data in need of a theory; they were not written to promote any specific theoretical interpretation. Others, including Bachmann, have noted these data previously.

Aside from reflecting space limitations, the omission of Cohene's work reflected our view that earlier

researchers had not fully appreciated the theoretical implications of masking by common onset. In our more comprehensive treatment of object substitution⁵, cited in our TICS article, we referenced not only Cohene and Bechtoldt^{4–6}, but others such as Markoff and Sturr⁷, who reported common-onset masking effects but did not view them as especially critical of extant theories.

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Letters to the Editor

Letters to the Editor concerning articles published in *Trends in Cognitive Sciences* are welcome.

The authors of the article referred to are given an opportunity to respond to any of the points made in the letter. The Editor reserves the right to edit letters for publication. Please address letters to:

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