

Correspondence

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A methodological flaw in ‘The neural basis of flashback formation: the impact of viewing trauma’

Discussions of post-traumatic stress have often emphasized the disordered ways in which intrusively remembered episodes are interpreted, recollected and re-experienced, during the months after those episodes take place. Relatively little emphasis has been placed on the way in which such episodes are processed at the time of their initial occurrence. This is reflected in our diagnostic practice, and in our psychological theorizing. An important series of recent papers (Bourne *et al.* 2013; Clark *et al.* 2014, 2016) suggests that this is a mistake. These papers establish that intrusively remembered episodes are processed in a distinctive way at the time when they are first experienced. They thereby raise the question of *how* the initial processing of intrusively remembered episodes differs from the initial processing of normally remembered episodes. That question has received less attention than it deserves.

One possible hypothesis is that the difference in question is a difference of emotional intensity. According to this view intrusively remembered episodes differ from other episodes just because the emotional responses that they elicit, at the time when they are first experienced, are extreme. An alternative view says that it is not mere extremity, but is instead extreme *negativity*, that distinguishes intrusively remembered experiences from normally remembered ones. Further hypotheses could be generated by the adding of further precisifications: Perhaps the episodes that are prone to being intrusively remembered are characterized by extremes of *outwardly directed* negativity; perhaps by extremes of fear, of helplessness, of dissociation from the self, of threat to life, or of threat to status. Each of these is, on the face of it, a plausible hypothesis.

In contrast to this broad family of emotion-based hypotheses, there is an equally broad family of hypotheses that take the initial processing of intrusively remembered episodes to be marked, not only by emotion, but also by some more purely *cognitive* peculiarity. One such hypothesis says that the initial processing of intrusively remembered episodes is marked by a brief shift towards a more schizotypal style of cognition (Steel & Holmes, 2007). As before, more or less specific hypotheses might be generated that belong to this broadly cognitive family.

Bourne *et al.* suggest that the evidence given in their 2013 study favours hypotheses of this second type. They write that ‘although intense emotional reaction may be a necessary condition for flashback formation it appears not to be sufficient’ (p. 1529). The grounds on which they make this claim are flawed.

Bourne *et al.* (2013) used functional magnetic resonance imaging (fMRI) data from participants who were watching traumatic scenes, in order to compare the haemodynamic response to those scenes that did appear in the participants’ subsequent flashbacks – (as gauged from their diary entries over the following week) – with the response to those scenes that did not appear in such flashbacks, but that did have the potential to do so (as indicated by the fact that they appeared in the diaries of other participants). In order to control for the ‘subjective emotional experience of the flashback and potential scenes’ (p. 1525), participants were given a written description of each of the 20 scenes that they had been shown, a week after having been shown them. They gave subjective ratings of ‘how distressed and emotional they found each of them’, on a 10-point scale (Bourne *et al.* 2013, Supplementary materials). These retrospective ratings were then used as covariates in the analysis of the fMRI data. The authors report that: ‘The same pattern of results was found with [these] covariates (with slightly reduced spatial extent) as was initially found. Therefore these [emotional] variables are unlikely to explain the activation pattern associated with flashback encoding’ (p. 1526).

The flaw in this last piece of reasoning is one that often arises when coarse-grained and fine-grained data are mixed together in a causal inference. It is hard to avoid when introspection and fMRI are used in combination. The problem originates in a violation of what is sometimes called the ‘faithfulness’ constraint (Spirtes *et al.* 1993)[†]. It can be illustrated with a simple analogy.

Suppose one has some fine-grained measurements of rainfall, and also some coarse-grained measurements of weather. (The latter measurements might be based on judgments that were made a week after the day in question, on the basis of recollection, on a 10-point scale.) Suppose that one finds a relationship between these fine-grained rainfall measurements and the subsequent growth of one’s lawn, during the following week. This statistical relationship is likely to remain, in only somewhat diminished form, if one

[†] The note appears after the main text.

adds the coarse-grained assessment of weather as a covariate in one's analysis. That is simply because rainfall will correlate with lawn growth within the broad class of somewhat showery days, just as it will within the broad class of rather rainy days. It would be a mistake to take the persistence of rainfall's effect, after coarse-grained weather measurements have been factored in, as being evidence that the relationship between rainfall and one's lawn is not mediated by – or identical to – an effect of weather.

Similarly, if one has a fine-grained measurement of the activation in certain brain areas during flashback-provoking episodes, and if one also has a coarse-grained measurement of the emotion that was experienced during these episodes, one should expect that the pattern of covariation between brain activations and flashbacks will persist, in only somewhat diminished form, after the contribution of coarse-grained emotion has been taken into account. Such persistence is no indication that the observed relation between brain states and flashbacks was not mediated by – or identical to – an effect of emotion.

Bourne *et al.* (2013) do remark upon a related methodological difficulty, but the difficulty that they note is not the crucial one. They acknowledge that their measure of emotion 'was retrospective and may have been contaminated by the presence of intrusive recollections for the Flashback events in the intervening week' (Bourne *et al.* 2013, Supplementary materials). They take this difficulty to be mitigated by the thought that 'any contamination effect would likely have increased the retrospective rating of the emotionality of intruding scenes thereby reducing the contrast effect once emotionality was co-varied'. This addresses a different difficulty from the one that is outlined above. The difficulty above originates, not from the time at which emotional responses were reported, nor from the possibility that those responses might be 'contaminated', but from the fineness of grain with which such responses can be measured. It reflects the inherent limitations of affective introspection (Haybron, 2007), and is therefore difficult to avoid.

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Declaration of Interest

None.

Note

- ¹ The term 'faithfulness constraint' belongs to the literature on causal modelling, where it is explicated with reference to the mathematical apparatus of directed acyclic graphs. The motivation for it can be understood informally as being the idea that *B* mediates the causal interaction between *A* and *C* only if there is no further information to be had from *A* about *C*'s occurrence, once the information from *B* has been taken into account.

References

- Bourne C, Mackay CE, Holmes EA (2013). The neural basis of flashback formation: the impact of viewing trauma. *Psychological Medicine* **43**, 1521–1532. Supplementary material online at: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3806039/bin/S0033291712002358sup001.doc>
- Clark IA, Holmes EA, Woolrich MW, Mackay CE (2016). Intrusive memories to traumatic footage: the neural basis of their encoding and involuntary recall. *Psychological Medicine* **46**, 505–518.
- Clark IA, Niehaus KE, Duff EP, Di Simplicio MC, Clifford GD, Smith SM, Mackay CE, Woolrich MW, Holmes EA (2014). First steps in using machine learning on fMRI data to predict intrusive memories of traumatic film footage. *Behaviour Research and Therapy* **62**, 37–46.
- Haybron DM (2007). Do we know how happy we are? On some limits of affective introspection and recall. *Noûs* **41**, 394–428.
- Spirtes P, Glymour CN, Scheines R (1993). *Causation, Prediction, and Search*. Springer: London.
- Steel C, Holmes EA (2007). The role of involuntary memories in posttraumatic disorder and psychosis. In *Involuntary Memory* (ed. J. H. Mace), pp. 68–86. Blackwell Publishing: Oxford.

C. MOLE

Department of Philosophy and Cognitive Systems, University of British Columbia, 1866 Main Mall, E370, Vancouver BC, V6T 1Z1, Canada

(Email: cmole@mail.ubc.ca)