The pattern of memory and perceptual dysfunctions in recreational ecstasy users

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Declaration

I declare that this thesis reports my original work, that no part has been previously accepted and presented for the award of any degree or diploma from any university, and that, to the best of my knowledge, no material previously published or written by any other person is included, except where due acknowledgement is given.

John Anthony Brown

"If MDMA neurotoxicity in humans is a myth, then it is a myth with a very heavy serotonergic component."

(Turner & Parrott, 2000)

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Abstract

There is a growing body of evidence that the main psychoactive ingredient of the recreational drug "ecstasy" (methylendioxymethamphetamine; MDMA) causes lasting changes to the serotonin system in both animals and humans, including the hippocampus (involved in memory) and the occipital lobe (involved in visual perception). Previous studies have often found memory deficits in ecstasy users. However, the results have been far from consistent across studies. None of the methods used to date have adequately isolated the hippocampal component of memory from the contribution of other brain regions. Three memory studies were conducted in this thesis to clarify which components and processes of memory are in deficit in ecstasy users.

In the first memory study, ecstasy users (n=32) did not differ from non-drug using controls (n=29) on implicit memory (automatic non-conscious retrieval, as revealed by a stem-completion task), or explicit memory (conscious recollection, as revealed by stem-cued recall). In the second memory study, no significant differences were found between ecstasy users (n=30) and non-drug using controls (n=34) on tests designed to clarify the findings on explicit memory, or on two standard neuropsychological tests of long-term memory (prose recall and Auditory Verbal Learning Test) that allowed greater use of elaborative processing at study. In the third memory study, a number of tests were applied that differed in their elaborative processing demands, including the California Verbal Learning Test, Visual Paired Associates, and Verbal Paired Associates. Ecstasy users (n=32) had poorer recall, and made less strategic use of elaborative processing compared to both cannabis-using controls (n=33) and non-drug using controls (n=33). Also, on a novel test of elaborative processing ("Verbal Triplet Associates"), both cannabis users and ecstasy users had memory deficits on the first trial, but only ecstasy users had a significant learning deficit over successive trials. On the basis of the localisation of the components and processes of memory in literature, it was concluded that long-term memory deficits in ecstasy users may reflect changes in elaborative processes localised in the frontal lobes, or global deficits, rather than just changes to the memory functions of the hippocampus.

With regard to visual perception, no studies have been published to date that have examined MDMA-related changes to the behavioural functioning of the occipital lobe in humans. In the current thesis, this was investigated using the tilt aftereffect illusion. In accordance with expectations, ecstasy users had a larger tilt aftereffect compared to

non-drug using controls (n=34). Unexpectedly, this result was only obtained for a subset of 12 ecstasy users (out of n=30) who had not used amphetamines in the recent past. It was concluded that the results for ecstasy users who had not recently used amphetamines were consistent with the proposal that ecstasy-related serotonergic changes in the occipital lobe broaden the tuning bandwidth of orientation sensitive neurons, and that the recent use of amphetamines appears to counteract that effect.

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