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Can criminals use propranolol to erase crime-related memories?  
A response to McGorrery (2017)

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Abstract
Technology for detecting incriminating knowledge in suspects, such as ‘brain fingerprinting’, raises several ethical and practical difficulties. In a recent article, McGorrery suggests that criminals may use propranolol to modify their memories for a crime and thereby trick ‘brain fingerprinting’ technology. While we agree that there are many limitations and concerns regarding the use of such technology in criminal proceedings, we explain why propranolol usage by offenders is unlikely to undermine knowledge detection technology.

Keywords
Memory reconsolidation, memory consolidation, lie detection, brain fingerprinting, emotional memory, propranolol, science and the law

Novel technologies aimed at detecting incriminating knowledge in suspects present a difficult case for the law. Such technology holds the potential to bring a new line of evidence to bear in criminal trials, possibly enabling more successful prosecutions of guilty suspects and fewer mistaken convictions of innocent individuals. Proponents of ‘brain fingerprinting’, for example, claim that they can detect the presence or absence of crime-related knowledge with essentially perfect accuracy by analysing a specific component of a suspect’s brain signals.1 However, intruding upon the minds and brains of suspects to glean evidence, especially against their will or without the capacity to resist, raises a number of ethical and legal concerns related to human rights, such as the rights to privacy, silence and freedom of thought. Ethical concerns aside, the value of such technology in criminal proceedings would be seriously challenged if it could be easily undermined.

In his recent critique, McGorrery2 considers a novel means by which criminals might undermine the ability of brain fingerprinting technology to detect incriminating knowledge. While McGorrery focuses specifically on brain fingerprinting, it should be noted that his critique — and our response to it — could apply equally to many other technologies aimed at detecting concealed information that may be used in the courtroom. McGorrery points to recent research indicating that the drug propranolol can be used to interfere with

memory storage, and suggests that a criminal might purposely use propranolol to render undetectable their memories of a crime, or even effectively erase these memories. Although McGorry’s consideration of the legal and ethical implications of these intriguing lines of research is an excellent example of the cross-disciplinary dialogue argued for in previous discussions of human memory manipulation, we believe it misconstrues the current evidence base regarding the memory-modifying effects of propranolol.

Specifically, we find highly dubious the implication that a criminal might successfully ‘forget’ their misdeeds through the purposeful use of propranolol to block memory consolidation or reconsolidation. If a drug or other procedure was capable of inducing amnesia for knowledge of an experienced event, then this would certainly place severe limitations on the use of a knowledge detection technology as a means of determining guilt or innocence. The question is whether propranolol is likely to produce such effects. Despite some remarkable applications of propranolol in tackling maladaptive emotional memories, the findings do not suggest much scope for the use of propranolol in erasing crime-related knowledge.

In several studies it was demonstrated that, while propranolol effectively neutralised a defensive reflex towards a stimulus that participants had learned signalled danger, the explicit knowledge of what had been learned remained intact. Similarly, participants who were treated for their fear of spiders, and who showed a dramatic decrease in fear and defensive behaviour after treatment with propranolol, nevertheless remembered previous experiences with spiders and that they had previously been afraid. Finally, when patients have been treated for traumatic memories with propranolol, they have retained knowledge of the traumatic event and, in our experience, sometimes even report that they are better able to think of and process the event now that the emotional burden has been reduced. In light of such findings, it has been argued by researchers in the field that the disruption of memory consolidation and reconsolidation are likely to have their most potent effects on the emotional valence of memories rather than on knowledge, such that intense emotional responses may be reduced, while explicit knowledge remains intact.

Some studies do indicate that propranolol can affect declarative memory for emotional events, but important caveats apply. Propranolol in such studies did not strictly erase participants’ memories but only nullified the usual emotional enhancement of memory that occurs for emotional events. Hence, participants still retained knowledge of the procedures they had undergone, and much of what they had seen, but their memories of emotional events were not better than for neutral events, as would normally be the case.

In studies aiming to detect concealed information through reaction times and physiological measures, emotion and arousal have been found to have only minor effects on the ability to detect guilty participants. This is partly explained by central details of the crime being so salient to perpetrators that a ceiling effect is reached: participants remember them regardless of whether they are emotionally tinged or were encoded under arousing conditions. For peripheral details, arousal may even reduce memory, such that a criminal taking propranolol before or shortly after a crime might ironically increase the likelihood that they remember peripheral information that can be detected later. Finally, it should be stressed that many such experimental studies involve memories for events that have very little importance to the participants being tested. Even diminished memories from more personally meaningful events – such as committing a crime – are likely to be stronger than unaltered memories induced by an emotional slideshow or other experimental task.

Based on these findings, the idea that a criminal might wilfully remove or significantly diminish their explicit knowledge of having committed a crime seems far-fetched. Indeed, the perpetrator would not only have knowledge of what transpired but also retain further knowledge of trying to eradicate that memory, potentially making certain parts of their memory even stronger or more salient.

Fully understanding the implications of emerging technologies for detecting concealed information will require dialogue between scientists, ethicists, and legal scholars.

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2. Propranolol’s primary pharmacological effect is not to block the creation of norepinephrine, but to block beta-adrenergic receptors and thereby block the effects of whatever norepinephrine is around those receptor sites. McGorry states that rather than blocking the immediate storage (‘consolidation’) of memory after an event, propranolol ‘can still work well after the event (eg, two months) by disrupting reconsolidation’. Though it is true that propranolol is being investigated as a means of disrupting traumatic memory reconsolidation, which can occur at time points far removed from the initial experience, the citation referring specifically to a two-month period is a study of almost immediate post-trauma propranolol administration. The two-month period mentioned in this study denotes when diagnostic tests for post-traumatic stress disorder (PTSD) were conducted.
and practitioners. McGorrery has taken a much-needed step in the direction of further communication between these often-disconnected communities. We agree wholeheartedly with McGorrery that the admission into legal proceedings of brain fingerprinting technology, as well as other techniques geared towards detecting information, should be met with a healthy dose of scepticism, and that concerns over the ethical implications of their use, as well as over their validity, should be taken seriously. While we, as scientists engaged in memory research, believe there are many limitations to the use of memory detection techniques in the courtroom, it is our view that the manipulation of memory using propranolol is unlikely to be a major one.

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