



The acute effects of 3,4-methylenedioxymethamphetamine and methamphetamine on driving: A simulator study

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ABSTRACT

Objectives: Illicit drugs such as MDMA and methamphetamine are commonly abused drugs that have also been observed to be prevalent in drivers injured in road accidents. Their exact effect on driving and driving behavior has yet to be thoroughly investigated.

Methods: Sixty-one abstinent recreational users of illicit drugs comprised the participant sample, with 33 females and 28 males, mean age 25.45 years. The three testing sessions involved oral consumption of 100 mg MDMA, 0.42 mg/kg methamphetamine, or a matching placebo. The drug administration was counter-balanced, double-blind, and medically supervised. At each session driving performance was assessed 3 h and 24 h post drug administration on a computerized driving simulator.

Results: At peak concentration overall impairment scores for driving ($F_{2,118} = 9.042$, $p < 0.001$) and signaling ($F_{2,118} = 4.060$, $p = 0.020$) were significantly different for the daytime simulations. Performance in the MDMA condition was worse than both the methamphetamine ($p = 0.023$) and placebo ($p < 0.001$) conditions and the methamphetamine condition was also observed to be worse in comparison to the placebo ($p = 0.055$). For signaling adherence, poorer signaling adherence occurred in both the methamphetamine ($p = 0.006$) and MDMA ($p = 0.017$) conditions in comparison to placebo in the daytime simulations.

Conclusions: The findings of this study have for the first time illustrated how both MDMA and methamphetamine effect driving performance, and provide support for legislation regarding testing for the presence of illicit drugs in impaired or injured drivers as deterrents for driving under the influence of illicit drugs.

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1. Introduction

Interest in the prevalence of drug use and driving under the influence of drugs has increased over the past decade with commonly used illicit and prescribed drugs being known to increase the risk of car accidents (Drummer et al., 2004). Illicit drugs such as tetrahydrocannabinol (THC), 3,4-methylenedioxymethamphetamine (MDMA) and methamphetamine are commonly abused drugs that have also been observed to be prevalent in drivers injured in road accidents (Drummer et al., 2011). Drugs in the amphetamine class, such as methamphetamine and MDMA, are the most widely used illicit substances after cannabis (Degenhardt et al., 2004). Given the psychostimulant properties

of amphetamines, and the documented effects of acute administration of MDMA and methamphetamine on cognitive processes ostensibly critical to driving, studies examining driving performance whilst under the effect of MDMA or methamphetamine in controlled conditions is of critical importance.

Methamphetamine acts as an indirect agonist at noradrenaline, dopamine and serotonin (5-HT) receptors. It attenuates monoamine metabolism by inhibiting monoamine oxidase, primarily through inhibiting dopamine reuptake and stimulating dopamine release (Clemens et al., 2007). MDMA primarily instigates the release of 5-HT from presynaptic terminals through the reversal of the reuptake transporter, thereby increasing 5-HT levels at postsynaptic receptors. MDMA consumption also releases noradrenaline and dopamine (Liechti and Vollenweider, 2000), although the stimulating effects of MDMA consumption is predominantly attributed to its effect on 5-HT. This central nervous system (CNS) stimulation results in noticeable behavioral effects, with recreational users reporting sociability enhancement, increased alertness, and energy boosting effects (Hart et al., 2005; Solowij

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