ILLEGAL DRUG USE AND MEMORY: A SYSTEMATIC REVIEW

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INTRODUCTION

This systematic review examined effects of illegal drug use on prospective memory (PM) as well as the link between the amount of illegal drug use and severity of PM deficit. PM is the ability to complete an intended action at a specified future point in time or, simply, remembering to remember (Walter & Meier, 2014). PM has multi-phases which are (a) planning a future activity (intention formation), (b) keeping the intended future event activity in mind (intention retention), (c) initiating the activity (intention initiation), and (d) carrying out the activity according to the previously formed plan (intention execution) (Kliegel et al., 2002). There are two forms of prospective memory: time-based PM that involves remembering to perform a planned action at a particular future time point (e.g., attending a lecture at 12.00pm) and event-based PM that involves remembering to perform a planned action when a particular event occurs (e.g., a pilot remembering to perform specific safety procedures before landing). In everyday life, PM plays a very important role as it governs our ability to organise our time in an efficient and independence way. The failures of PM can be irritating (e.g., forgetting to buy bread on the way home from work) as well as life threatening (e.g., forgetting to take daily medications; Terrett et al. 2014). PM relies on multiple neurotransmitter systems, including dopamine (DA), serotonin (5-HT) and norepinephrine (NE) that have been thought to be interfered by illegal drug use (Vegting, Reneman & Booji, 2016). For example, the regular MDMA user group showed a reduction of cortical 5-HT transporter binding compared to the non-user group (Semple et al., 1999). Furthermore, Volkow et al. (2009) demonstrated that Cocaine and Methamphetamine reduced dopamine release and dopamine D2 receptors in drug users. Therefore, illegal drug use has been associated with PM impairment (McHale & Hunt, 2008).

METHOD

A computer-based search involving the Science Direct, PudMed, PMC and Birkbeck Library databases and a backwards citation (i.e., references in each of the journal articles retrieved were checked) were conducted. The search was limited to English-language publications with human participants and new findings. The quality of included studies was assessed based on sample type, sample size, abstinence period, testing methods and controlling for confounding factors. Each category was defined as good, moderate or low based on the information they have supplied. Overall, studies with three and more categories that were defined as good met requirements for good quality of evidence; studies with three and more categories that defined as good or moderate provided moderate quality of evidence. The rest of the studies provided low quality of evidence.

Table 1: Quality assessment criteria

Quality assessment of...	Low (L)	Moderate (M)	Good (G)
Sample type	Patient population	Student population	General population
Sample size	<50	<100 and >50	>100
Abstinence period	<3 or not mentioned	<7 and >3	>7
Testing methods	Self-report tests	Lab-based tests	Self-report and Lab-based tests
Control for confounding factors	One factor or not at all	two factors	three or more factors

RESULT

Twenty-five studies were included in this systematic review. As Table 1 shows, of these, four studies met the requirement for good quality of evidence, eighteen studies met the requirements for moderate quality of evidence and three studies met the requirement for low quality of evidence. The studies were divided into two broad categories based on used testing methods: studies with self-report testing methods that measure three aspects of PM (short-term habitual, long-term episodic and internally cued); and studies with lab-based testing methods that assess two aspects of PM (event-based and timed-based).

Table 2: Quality assessment of 25 studies included in the systematic review

Reference	Sample type	Sample Size	Testing Methods	Control for confounds	Abstinence Period	Quality of Evidence
Hadjiefthyvoulou et al., 2010	M	M	G	G	G	G
Bartholomew et al., 2010	M	G	G	G	G	G
Gallagher et al., 2014 study 1	M	G	M	G	G	G
Montgomery et al., 2007	G	M	L	G	G	G
Weinborn et al., 2011b	G	M	G	M	M	M
Heffernan et al., 2001b	M	M	L	G	L	M
Heffernan et al., 2001a study 1	G	M	L	M	L	M
Heffernan et al., 2001a study 2	G	M	L	M	L	M
Rodgers et al., 2001	G	G	L	M	L	M
Hadjiefthyvoulou et al., 2011	M	M	M	G	G	M
Montgomery et al., 2010	M	M	M	G	G	M
Arana et al., 2011	M	G	G	L	L	M
Ramaekers et al., 2009	G	L	M	L	G	M
McHale et al., 2008	G	M	M	M	L	M
Montgomery et al., 2012	M	L	M	G	M	M
Weinborn et al., 2011a	L	M	G	G	L	M
Rendell et al., 2009	L	L	M	G	G	M
Rendell et al., 2007	G	M	M	G	L	M
Terrett et al., 2014	G	M	M	G	L	M
Zakzanis et al., 2003	M	L	M	M	G	M
Gallagher et al., 2014 study 2	M	G	M	M	G	M
Rodgers et al., 2006	G	G	L	M	L	M
Cuttler et al., 2012	M	G	L	L	L	L
Rodgers et al., 2003	G	G	L	L	L	L
Ciorciari et al., 2011	G	G	L	L	L	L

Table 3: The overview of eleven studies with self-report testing methods

Reference	Short-Term PM Deficit	Long-Term PM Deficit	Internally Cued PM Deficit
Heffernan et al., 2001a	✓	✓	✓
Heffernan et al., 2001b, study 1	✓	✓	✓
Heffernan et al., 2001b, study 2	✓	✓	✗
Rodgers et al., 2001	✓	✓	✓
Rodgers et al., 2003	✗	✓	✗
Montgomery & Fisk, 2007	✗	✓	✓
Hadjiefthyvoulou et al. 2010	✓	✗	✗
Bartholomew et al., 2010	✗	✗	✗
Weinborn et al., 2011a	✓	✓	✓
Weinborn et al., 2011b	✗	✗	✗
Ciorciari & Marotte, 2011	✗	✓	✗

Table 4: The overview of thirteen studies with lab-based testing methods

Reference	Event-based PM deficit	Time-based PM deficit
Zaknanis et al., 2003	✓	✓
McHale & Hunt, 2008	✗	✓
Montgomery et al., 2010	✓	✗
Hadjiefthyvoulou et al., 2010	✓	✓
Hadjiefthyvoulou et al., 2011	✓	✓
Weinborn et al. 2011a	✓	✓
Montgomery et al., 2012	✓	✓
Gallagher et al., 2014, study 1	✓	✓
Gallagher et al., 2014, study 2	✓	✓
Rendell et al., 2007	✓	✓
Rendell et al., 2009	✓	✓
Terrett et al., 2014	✓	✓
Bartholomew et al., 2010	✓	✓

Key: ✓= present ✗= not present

CONCLUSION

Most studies employing self-report measures of PM, have shown mixed findings on the effect of illicit drug use on PM, but more evidence is in favour of illegal drugs induced time-based PM impairment, also some deficits in short-term and internally cued PM. Whereas, studies with lab-based testing method have demonstrated consistent findings with illegal drug users scoring worse than non-users on the various types of psychological lab-based test battery. This systematic review also provides mixed results on the link between level of illicit drug consumption and PM deficit. Some studies demonstrated that increasing lifetime dose, higher levels of consumption and increasing frequency of illicit drug use were associated with poorer PM performance whereas, some other studies failed to find the link. Overall, the pattern of findings from studies in this review suggests that PM, a crucial aspect of day-to-day cognitive functioning, is impaired among illegal drug users.

CONFLICT OF INTEREST

The authors wish to declare that no conflicts of interest arise from their involvement in the research reported in this article.

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