Recreational cocaine use is associated with attenuated latent inhibition

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HIGHLIGHTS

- Recreational cocaine users show attenuated latent inhibition (LI).
- This attenuated LI is not mediated by other drugs use or psychological health.
- Recreational levels of cocaine may affect inhibitory attentional processes.

ARTICLE INFO

ABSTRACT

Introduction: Evidence has linked chronic cocaine use with various cognitive deficits; however few studies have investigated the effects of recreational (non-dependent) use. The present study aimed to assess whether recreational users show deficits in latent inhibition (LI: a measure of delayed learning of an association between 2 stimuli, one of which has been previously exposed (PE) without consequence and thus deemed irrelevant).
Methods: Using a quasi-experimental between groups design, recreational cocaine users (n = 21), poly-drug users (n = 17) and drug-naive controls (n = 18) were compared on a LI task. Questionnaires assessing psychological health and drug use were also completed.
Results: There was a statistically significant interaction between condition (PE vs non PE) and group (cocaine, polydrug and control); cocaine users scored lower in the PE condition compared to polydrug users and controls, indicating quicker learning.
Conclusions: Recreational cocaine users show attenuated LI reflecting reduced ability to filter out irrelevant stimuli enabling faster learning of a PE irrelevant and novel stimuli association. This does not appear to be a result of schizotypy and/or other drug use. Thus even at recreational levels, cocaine use may be sufficient to affect inhibitory attentional processes.

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1. Introduction

Cocaine is the second most used substance in Europe after cannabis. Approximately 4 million people reported using cocaine in the last year, 2 million have used it in the last month (EMCDDA, 2011) and 6% of first time users are estimated to meet dependence within 5 years (Wagner & Anthony, 2007). Cocaine's status as a drug of privilege has been receding dramatically; increased trafficking infrastructure and decreasing purity have driven down prices (EMCDDA, 2008) precipitating a considerable increase in recreational consumption.

Clinical guidelines for classifying recreational cocaine use are absent (Smith, Jones, Bullmore, Robbins, & Ersche, 2014) and researchers have used various definitions e.g. monthly use without dependence (Colzato & Hommel, 2009); >0.5 g per month but not meeting dependence criteria (Vonmoos et al., 2013); intranasal use within the last year, but <10 occasions within the last month (Soar, Mason, Potton, & Dawkins,

2012). Given the rapid increase in recreational (non-dependent use) as opposed to compulsive (dependent) use, it is surprising that the focus of most research assessing neuropsychological effects of cocaine has been on chronic (dependent) use (e.g. Verdejo-Garcia, Bechara, Recknor, & Perez-Garcia, 2006; Fillmore & Rush, 2002; Kubler, Murphy, & Garavan, 2005). Only a handful of studies have explored the neuropsychological effects of recreational use (Colzato, Van den Wildenberg, & Hommel, 2007, 2009b; Colzato, Huizinga, & Hommel, 2009a; Colzato & Hommel, 2009; Soar et al., 2012; Vonmoos et al., 2013; Sellaro, Hommel, & Colzato, 2014) and with the exception of one study (Vonmoos et al., 2013), all have indicated inhibitory deficits. Colzato et al. (2007) reported similar response inhibition deficits (in the stop-signal paradigm) in recreational cocaine users (monthly cocaine use, for a minimum of two years without dependence) relative to chronic users and the magnitude of this deficit was positively correlated with lifetime exposure.

Deficits in inhibitory input processes (i.e., attentional selection) have also been reported in recreational users (Colzato & Hommel;, 2009) as measured by inhibition of return (a phenomenon that occurs when,

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immediately following an event at a peripheral location, responses are delayed for stimuli appearing at that cued location compared to stimuli appearing elsewhere). The magnitude of impairment in this case, however, was not related to lifetime cocaine exposure.

Latent inhibition (LI) is a similar inhibitory input process that refers to the unconscious cognitive mechanisms that ensures that attentional resources do not become occupied with stimuli which past experience has shown to be irrelevant. It is an automatic process which prevents an organism from being overwhelmed by sensory and cognitive information. LI occurs after repeatedly presenting a stimulus that does not have any inherent value and is not followed by any important consequence (whether adverse or favourable). After repeated inconsequential presentations, that stimulus is subsequently deemed irrelevant. This suggests that pre-exposure (PE) to a stimulus without consequence results in a reduction in its subsequent processing, and this reduction retards the learning of later associations between it and another stimuli. LI is illustrated by the reduced ability to acquire a new association to a stimulus that has previously been deemed irrelevant by comparison with a novel stimulus. Attenuated or absent LI reflects a weakening of associative learning following a stimulus which has had no consequence associated with it.

The current study was designed to explore potential disruptions in LI in recreational cocaine users whilst controlling for other drug use and trait schizotypy. Given the high rate of polydrug use among recreational drug users (e.g. Kelly & Parsons, 2008; Grov, Kelly, & Parsons, 2009), isolating the effects of cocaine on LI is a difficult task. To minimise polydrug effects a control group of non-cocaine users who report the use of other drugs except cocaine (polydrug users) as well as a drug-naive (control) group were employed. Elevated levels of schizotypy (a continuum of personality characteristics and experiences ranging from normal dissociative, imaginative states to extreme states related to psychosis) have previously been reported in recreational cocaine users (Soar et al., 2012) and schizotypy itself has been associated with disrupted LI (e.g. Lubow & De la Casa, 2002; Tsakanikos, Sverdrup-Thygenson, & Reed, 2003; Tsakanikos & Reed, 2004). Thus schizotypy is a potential confound that needs to be taken into consideration when assessing LI in recreational cocaine users. It is hypothesised that recreational cocaine users will show attenuated LI (i.e. lower scores in the PE condition) compared with non-cocaine poly-drug users and drug-naive controls. Performance on the NPE condition is generally homogenous for all participants (Braunstein-Bercovitz & Lubow, 1998), so no significant group differences are expected here.

2. Methods

2.1. Design

A quasi-experimental between groups design, with two independent variables: group (cocaine, polydrug, controls) and LI condition (pre-exposed [PE] or non-pre-exposed [NPE]). The dependent variable is the score (number of trials required to detect contingency rule) on the LI task.

2.2. Participants

2.2.1. Cocaine users

Twenty one recreational cocaine users (i.e. used intranasally within the last 6 months, but no more than 5 times within the last month) (12 male, 9 female; mean age: 24.43 ± 2.09 years) were required to refrain from cocaine use for at least one week prior to the study. Use of other recreational drugs (excluding cannabis and alcohol) was defined by the same parameters (see Table 1).

2.2.2. Polydrug users

Seventeen polydrug users (8 male, 9 female; mean age: 24.12 ± 2.52 years) reporting no cocaine use but use of other recreational substances were recruited as a drug comparison group.

Table 1
Participant characteristics, NART, SPQ-B and BSI measures in recreational cocaine users, polydrug users and controls.

	Cocaine	Polydrug	Controls
Age	24.43(2.09)	24.12(2.52)	28.89(8.04)[*]
Gender (M/F)	12/9	8/9	6/12
Ethnicity % (n)			
White	76 (16)	94 (16)	78 (14)
Black	10 (2)	–	11(2)
Asian/Chinese	5 (1)	–	12 (2)
Mixed ethnicity	5 (1)	6 (1)	–
Other	5 (1)	–	–
Highest educational achievement %(n)			
A-level	5 (1)	24 (4)	11 (2)
NVQ	5 (1)	–	6 (1)
Degree	67 (14)	59 (10)	56 (10)
Postgraduate	10 (2)	18 (3)	28 (5)
NART	108.52(10.39)	115.29(8.34)	113.72(9.60)
SPQ-B Total	6.62(3.93)	8.18(4.61)	6.00(4.13)
Cognitive perceptual	1.62(1.75)	2.59(2.03)	2.17(2.07)
Interpersonal	2.52(1.89)	2.53(2.07)	2.09(1.95)
Disorganised	2.48(1.57)	3.06(1.89)	1.06(1.16)[**]
BSI total			
Somatisation	3.76(3.82)	4.34(3.01)	3.28(0.32)
Obsessive–compulsive	7.48(4.37)	7.00(2.76)	6.28(3.86)
Interpersonal	3.71(3.21)	3.94(2.44)	3.89(2.49)
Depression	5.62(4.39)	5.24(3.47)	5.00(4.89)
Anxiety	4.67(2.83)	3.29(2.20)	4.00(3.83)
Anger	3.19(2.32)	3.06(2.16)	2.83(2.98)
Phobic anxiety	1.86(2.63)	1.31(1.74)	1.11(1.45)
Paranoid Ideation	3.48(2.91)	3.06(2.28)	3.56(3.03)
Psychotism	2.95(2.18)	2.47(1.62)	2.06(3.00)
Additional Items	4.10(2.77)	4.06(2.14)	3.44(2.55)

[*] $p < 0.05$.
[**] $p < 0.001$.

2.2.3. Controls

Eighteen drug-naive individuals (6 male, 12 female; mean age: 28.89 ± 8.04 years) who reported no-drug use within the last year except for nicotine and alcohol were recruited as a control group.

Participants were recruited via word of mouth, through the researchers' social networks and through advertising around the University of East London (UEL). Exclusion criteria were: 1) current use of psychiatric medication or medication for epilepsy, 2) current treatment for any psychological problem or substance/alcohol dependency, 3) head injury, 4) pregnancy, and 5) drug and alcohol use at the time of testing (confirmed via Quantum Diagnostics Oral Fluid Test). All participants gave written informed consent, received no remuneration, and the study was approved by the UEL Ethics Committee.

2.3. Questionnaire measures

All participants provided demographic details, information regarding personal and family psychiatric histories and completed the well utilised UEL drug use questionnaire (Parrott, Sisk, & Turner, 2000) to assess drug use within the last 6 months, with additional questions pertaining to patterns of cocaine use and associated subjective effects

Cocaine dependence was measured using the Severity of Dependence Scale (SDS) a reliable, valid scale, with good internal consistency (Gossop et al., 1995). The SDS is a 5-item questionnaire with each item rated on a 4-point scale; 'never', 'sometimes', 'often' and 'nearly always', with scores awarded from 0 to 3 respectively. Total scores therefore ranged from 0 to 15, with an overall score of 4 or more indicating cocaine dependence. Participants then completed the following assessment measures in the order presented below.

2.3.1. The Brief Symptom Inventory (BSI; Derogatis, 1993)

A reliable and valid (Tate, Forchheimer, Maynard, Davidoff, & Dijkers, 1993) 53-item questionnaire measuring psychological distress