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Impact of severity of drug use on discrete emotions recognition in polysubstance abusers

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ABSTRACT

Neuropsychological studies support the association between severity of drug intake and alterations in specific cognitive domains and neural systems, but there is disproportionately less research on the neuropsychology of emotional alterations associated with addiction. One of the key aspects of adaptive emotional functioning potentially relevant to addiction progression and treatment is the ability to recognize basic emotions in the faces of others. Therefore, the aims of this study were: (i) to examine facial emotion recognition in abstinent polysubstance abusers, and (ii) to explore the association between patterns of quantity and duration of use of several drugs co-abused (including alcohol, cannabis, cocaine, heroin and MDMA) and the ability to identify discrete facial emotional expressions portraying basic emotions. We compared accuracy of emotion recognition of facial expressions portraying six basic emotions (measured with the Ekman Faces Test) between polysubstance abusers (PSA, $n = 65$) and non-drug using comparison individuals (NDCI, $n = 30$), and used regression models to explore the association between quantity and duration of use of the different drugs co-abused and indices of recognition of each of the six emotions, while controlling for relevant socio-demographic and affect-related confounders. Results showed: (i) that PSA had significantly poorer recognition than NDCI for facial expressions of anger, disgust, fear and sadness; (ii) that measures of quantity and duration of drugs used significantly predicted poorer discrete emotions recognition: quantity of cocaine use predicted poorer anger recognition, and duration of cocaine use predicted both poorer anger and fear recognition. Severity of cocaine use also significantly predicted overall recognition accuracy.

1. Introduction

Addiction is a chronic relapsing disorder characterized by persistent brain alterations associated with cognitive, motivational and emotional alterations (Goldstein and Volkow, 2002; Verdejo-Garcia et al., 2004). Neuropsychological studies have demonstrated extensive mid- and long-term cognitive alterations in individuals with substance use disorders (see Ersche and Sahakian, 2007; Verdejo-Garcia et al., 2004 for reviews), but there is disproportionately less research on the neuropsychology of emotional alterations associated with addiction. One of the key aspects of adaptive emotional functioning is the ability to decode emotional cues and recognize emotions in the faces of others, especially in relation to the six basic emotions: anger, disgust, fear, happiness, sadness and surprise (Adolphs, 2002). Emotion recognition is relevant to addiction in several regards. On the one hand, emotion recognition is fundamental for prosocial behavior, normal socialization and interaction (Blair, 2003), which is typically impaired in addiction (Reay et al., 2006; Roselli and Ardila, 1996; Homer et al., 2008). Moreover, simulation theories argue that the emotional states of others are understood and recognized by generating similar states in oneself (Goldman and Sripada, 2005), and evidence supports the link between altered emotion recognition and parallel alterations in emotion experience and behavioral manifestations (Calder and Young, 2005). These notions are particularly relevant to addiction according to the somatic marker theory, which posits that substance addiction is associated with abnormal activation and integration of emotional states involved in the experience of subjective urges (e.g., craving) and in the guidance of decision-making (Verdejo-Garcia and Bechara, 2009). Furthermore, the neural substrates of emotion recognition overlap with neural systems strongly involved in the escalation and maintenance of addiction, including the orbitofrontal cortex, the cingulate gyrus, the insula, and the ventral striatum (Verdejo-Garcia and Bechara,

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2009); and there is evidence of relative specificity in the neural systems supporting recognition of discrete emotions, with reliable and specific association between fear and the amygdala, disgust and the insula/basal ganglia, and anger and the lateral orbitofrontal cortex and the ventral striatum (Calder et al., 2001, 2004; Murphy et al., 2003). Therefore, it is reasonable to assume that drug use can be selectively associated with poorer recognition of discrete emotions as much as it is selectively associated with decreased functioning of particular cognitive and neural systems.

Available studies about the chronic (non-acute) deficits of discrete emotions recognition in addiction have mainly focused on alcohol dependence, and most studies have chosen to index the ability to estimate the intensity of the emotions displayed (but not accuracy of recognition). Studies on alcohol have shown that alcoholics tend to overestimate the intensity of the emotion displayed by facial expressions of happiness, anger and disgust (Foisy et al., 2007a; Kornreich et al., 2001; Townshend and Duka, 2003). Studies measuring recognition accuracy have shown that alcoholics have poorer recognition of expressions of sadness (Frigerio et al., 2002) and difficulties to discriminate anger and disgust (Townshend and Duka, 2003); although other studies have failed to find differences in emotion recognition accuracy between alcoholics and non-drug comparison individuals (Foisy et al., 2007b; Salloum et al., 2007). A comparison between alcohol and opiate dependents showed that alcoholics had overall poorer emotion recognition (across several emotions) than abstinent and methadone-maintained opiate dependents (Kornreich et al., 2003). A recent study comparing abstinent vs. methadone-maintained opiate users showed that methadone patients were overall slower but more accurate in the recognition of expressions of disgust; being accuracy positively correlated with lifetime use of methadone (Martin et al., 2006). Studies on cocaine and polysubstance psycho-stimulants abusers have shown relatively specific alterations in the recognition of expressions of fear (Kemmis et al., 2007; Verdejo-Garcia et al., 2007); however, the psycho-stimulant groups from both studies markedly differed on severity of drug exposure and patterns of other drugs co-abuse. Moreover, a more recent study did not find significant differences on emotion recognition between cocaine abusers and controls (Woicik et al., 2009). To our knowledge, no studies have been performed about the chronic effects of MDMA or cannabis use on emotion recognition, although there is suggestive evidence of acute and sub-acute effects of these drugs on facial emotional processing (Fusar-Poli et al., 2009; Hoshi et al., 2004). Overall, the evidence on chronic deficits of emotion recognition in addiction is scarce and has yielded considerably mixed results.

In addition, most studies have neglected the potential relevance of patterns of quantity and duration of drug use in relation to chronic emotion recognition deficits in the context of polysubstance abuse. Cognitive neuropsychological studies have successfully established an association between estimates of amount and duration of drug use and alterations in specific cognitive domains and neural systems (see Bolla et al., 1999, 2000, 2002, 2004; Fernández-Serrano et al., 2009; Goldstein et al., 2004; Verdejo-Garcia et al., 2005). Similarly, we expect that severity of use of different drugs can contribute to explain differential alterations in discrete emotions recognition, since all the brain areas involved in emotion recognition are related to the motivational brain circuitry implicated in addiction. Therefore, the aims of this study are: (i) to replicate previous findings showing poorer facial emotion recognition in polysubstance abusers (Verdejo-Garcia et al., 2007) using a larger sample and (ii) to explore the association between patterns of quantity and duration of use of several drugs co-abused (including alcohol, cannabis, cocaine, heroin and MDMA) and the ability to identify discrete facial emotional expressions portraying basic emotions in polysubstance abusers.

Table 1
Descriptive scores for the socio-demographic characteristics of polysubstance abusers (PSA) and non-drug using comparison individuals (NDCI).

Socio-demographic variables	PSA	NDCI	t/χ^2	p value
	Mean (SD)/ frequency	Mean (SD)/ frequency		
Age	31.78 (8.05)	26.40 (8.03)	3.03[a]	.003
Educational level (%)				
Primary	6.2	3.3		
Secondary	76.9	56.7	6.02[b]	.05
Superior	16.9	40		
Gender (%)				
Men	84.6	80	.312[b]	.58
Women	15.4	20		

[a] Value of Student's t.
[b] Value of Chi-square χ^2.

2. Methods

2.1. Participants

Sixty-five polysubstance abusers (PSA) aged 21–53 years (10 women), and 30 non-drug using comparison individuals (NDCI) aged 18–49 years (6 women), participated in this study; socio-demographic characteristics from both groups are displayed in Table 1. PSA and NDCI groups had similar distributions for gender and educational level but differed significantly on age; all these variables were explored in subsequent analyses. PSA were recruited during residential treatment at one therapeutic community ("Proyecto Hombre") in the city of Granada, Spain. This center provides psychological treatment and educational/occupational counseling in a controlled environment during an extended period of time. The PSA sample was composed of polysubstance users of several drugs, including cannabis, cocaine, heroin, alcohol, ecstasy (MDMA), amphetamines and benzodiazepines. Selection criteria for participants in the PSA group were: (i) meeting the DSM-IV criteria for substance dependence, (ii) absence of documented comorbid mood or personality disorders as assessed by clinical reports, (iii) absence of documented head injury or neurological disorders, (iv) not being currently enrolled in opioid substitution treatment or taking prescription drugs affecting Central Nervous System (CNS), and (v) minimum abstinence duration of 15 days before testing, although the mean duration of abstinence in the group was 33.10 weeks (SD = 12.38, range 12–80 weeks), so that it was possible to rule out alterations related to the acute or short term effects of the drugs used. Urine analyses for cannabis, benzodiazepines, cocaine, amphetamines, and heroin metabolites were conducted routinely at the treatment setting to confirm abstinence. NDCI were selected by means of local advertisements and snowball communication among adult people from the community. Selection criteria for these comparison participants were: (i) absence of current or past substance abuse, excluding past or current social drinking (less than ten drinks per week), (ii) absence of documented major psychiatric disorders, (iii) absence of documented head injury or neurological disorder, and (iv) not being on any medication affecting CNS. The mean amount of alcohol use in control participants was 8.85 units/month (SD = 20.66) and the mean duration of alcohol consumption was 6.70 years (SD = 7.29).

2.2. Instruments

2.2.1. Information on patterns of quantity and duration of drug use. Data regarding lifetime amount and duration of use of the different drugs was self-reported by participants and collected using the Interview for Research on Addictive Behavior (IRAB; Verdejo-Garcia et al., 2005). This interview provides an estimation of: (i) average lifetime monthly use of each substance (quantity per month) and (ii) total duration of use of each substance (duration in years). Descriptive scores for these variables in the present sample are presented in Table 2.

2.2.2. Test of emotion recognition: Ekman Faces Test (EFT). The Ekman Faces Test (EFT) is a computer task that assesses recognition of facial emotional expressions. The task uses stimuli from the Facial Expressions of Emotion: Stimuli and Tests (FEEST; Young et al., 2002). A series of 60 stimuli featuring faces portraying basic emotions were presented. Faces depicted expressions of anger, disgust, fear, happiness, sadness and surprise (6 emotions, 10 faces each). Photographs were posed by each of 10 models (six female, four male). Each face was presented on a computer monitor for a maximum of 5 s and individuals were asked to select one of the six expression labels (listed above) that best described the emotion expressed. The labels were visible throughout testing, thus minimizing working memory demands, and individuals were given as much time as they required to respond. No feedback was given regarding the appropriateness of their responses. For this study we were especially interested in measures of number of correct identifications for each of the six emotions displayed (discrete emotions recognition scores, ranging 0–10).