



Behavioural Pharmacology

Prevalence of executive dysfunction in cocaine, heroin and alcohol users enrolled in therapeutic communities

María José Fernández-Serrano^{a,*}, Miguel Pérez-García^{a,b}, José C. Perales^c, Antonio Verdejo-García^{a,b,*}^a Departamento de Personalidad, Evaluación y Tratamiento Psicológico, Facultad de Psicología de la Universidad de Granada, Campus de Cartuja, s/n, 18071 Granada, Spain^b Institute of Neurosciences F. Olóriz, Universidad de Granada, Spain^c Departamento de Psicología Experimental y Fisiología del Comportamiento, Universidad de Granada, Spain

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ABSTRACT

Many studies have observed relevant executive alterations in polysubstance users but no data have been generated in terms of prevalence of these alterations. Studies of the prevalence of neuropsychological impairment can be useful in the design and implementations of interventional programs for substance abusers. The present study was conducted to estimate the prevalence of neuropsychological impairment in different components of executive functions in polysubstance users enrolled in therapeutic communities. Moreover, we estimated the effect size of the differences in the executive performance between polysubstance users and non substance users in order to know which neuropsychological tasks can be useful to detect alterations in the executive functions. Study results showed a high prevalence of executive function impairment in polysubstance users. Working memory was the component with the highest impairment proportion, followed by fluency, shifting, planning, multi-tasking and interference. Comparisons between user groups showed very similar executive impairment prevalence for all the analyzed executive components. The best discriminating task between users and controls was Arithmetic (Wechsler Adult Intelligence Scale, WAIS-III). Moreover FAS and Ruff Figural Fluency Test was discriminating for fluency, Category Test for shifting, Stroop Colour-Word Interference Test for interference, Zoo Map (Behavioural Assessment of the Dysexecutive Syndrome, BADS) for planning and Six Elements (BADS) for multi-tasking. The existence of significant prevalence of executive impairment in polysubstance users reveals the need to redirect the action policies in the field of drug-dependency towards the creation of treatments addressed at the executive deficits of the participants, which in turn would facilitate the individuals' compliance and final rehabilitation.

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1. Introduction

The progressive increase of drug consumption-related problems has yielded an important number of research projects aimed at detecting neuropsychological alterations in drug-users' executive functions. Executive functions are an integrated group of abilities involved in the generation, supervision and monitoring of behaviours directed towards goals (Roberts et al., 1998; Stuss and Knight, 2002; Verdejo-García and Pérez-García, 2007a). Several research papers agree in the existence of alterations in different components of these executive functions in polysubstance users with a main consumption of cocaine (Fillmore et al., 2002; Bolla et al., 2003; Kubler et al., 2005; Verdejo-García and Pérez-García, 2007a), heroin (Lee and Pau, 2002; Pau et al., 2002; Verdejo-García et al., 2005b; Fishbein et al., 2007; Brand et al., 2008) or alcohol

(Ratti et al., 2002; Bjork et al., 2004). Moreover, these alterations negatively affect the users' family and social relations as well as their occupational status (Bechara et al., 2001; Moriyama et al., 2002). In addition, executive functions are also essential for the success of interventional programs that are carried out with substance users. Treatment of addiction-related disorders requires many intervention types some of which imply cognitive requirements, such as working memory, problem solving and abstract reasoning (Teichner et al., 2002). Other executive processes, such as inhibition and decision-making, have been associated with relapse occurrence in substance-dependent individuals (Franken, 2003; Tapert et al., 2004; Paulus et al., 2005). A number of studies agree that the existence of executive function alterations in users may interfere in the success of interventional programs undertaken within therapeutic communities (Fals-Stewart and Schafer, 1992; Bowden-Jones et al., 2005; Passetti et al., 2008). These findings reveal the necessity to design and implement programs tailored to the individuals' executive function limitations, since these may influence and condition the rehabilitation process itself.

Despite the fact that many studies have observed relevant executive alterations in terms of extension (number of affected regions) and

* Corresponding authors. Departamento de Personalidad, Evaluación y Tratamiento Psicológico, Facultad de Psicología de la Universidad de Granada, Campus de Cartuja, s/n, 18071 Granada, Spain. Tel.: +34 958 242 948; fax: +34 958 243 749.

E-mail addresses: mjfer@ugr.es (M.J. Fernández-Serrano), averdejo@ugr.es (A. Verdejo-García).

magnitude (effect size) in drug-users vs. non-users, no data have been generated to date in terms of prevalence of these alterations among users using several therapeutic contexts, including therapeutic communities. Studies on the prevalence of neuropsychological impairment have been undertaken for other disorders, such as Parkinson disease (Kulisevsky et al., 2008), multiple sclerosis (Massman et al., 1996; Karlinska et al., 2008), lupus (Carbotte et al., 1986; Monastero et al., 2001) and HIV (Cysique et al., 2004). These have proved useful in the design and implementation of interventional programs for the relevant patient populations. In the same fashion, studies on the prevalence of neuropsychological impairment in drug-users using therapeutic communities could be very useful and constitute the foundations for political actions aiming at supporting suitable programs according to the neuropsychological profile of the consuming population. Furthermore, it would be interesting to learn which tools have a higher discriminating potential in detecting alterations in the executive functions of substance-dependent individuals, since this could make both clinical assessment and research in the drug-dependence field easier.

Previous studies in our laboratory have shown alterations in several components of executive functions in polysubstance users under treatment (Verdejo-García et al., 2005a,b; Verdejo-García et al., 2006; Verdejo-García et al., 2007a,b; Verdejo-García and Perez-García, 2007a,b; Verdejo-García and Perez-García, 2008). In this paper we will use data from these studies and successive samples to establish the prevalence of executive impairment in polysubstance-dependent individuals as a reference for the potential application of specific interventions in order to address these impairments in the treatment setting. The specific goals of this paper are: (i) estimate the prevalence of the neuropsychological impairment in executive functions in polysubstance users enrolled in therapeutic community, taking as a reference the performance in the tests of a large group of non-drug-users; (ii) estimate the prevalence of executive impairment in several groups of polysubstance users classified according to their main drug consumed, and (iii) estimate the extent of the effect size of the differences in the executive performance of polysubstance users vs. non-users, and between the several groups of polysubstance users.

2. Method and materials

2.1. Participants

One hundred twenty-three poly-substance-dependent individuals (thirteen women), aged 18–58 years, and 67 healthy control individuals (eight women), aged 18–50 years, participated in this study. Poly-substance-dependent individuals and control participants were matched on variables of age, educational level and gender (see Table 1). Poly-substance-dependent individuals were recruited during their treatment at the therapeutic communities “Proyecto Hombre” and “Cortijo Buenos Aires”, in Granada-Spain. Both centers are residential therapeutic communities that provide psychological treatment and educational/occupational counseling in a controlled environment during an extended period of time. The dependent individuals sample was principally composed of polysubstance users who requested treatment for: cocaine, heroin, heroin + cocaine or alcohol use. According to the main substance leading to treatment, within the dependent individuals sample we can distinguish 4 groups of polysubstance users: cocaine poly-substance-dependents (CPSD; $n=74$), heroin poly-substance-dependents (HPSD; $n=34$) and alcohol dependents ($n=15$). In the HPSD sub-group we can distinguish in turn two sub-groups of users: heroin dependents ($n=17$), composed by those individuals who were users mainly of heroin, and heroin + cocaine dependents ($n=17$) composed by those individuals who were initially users mainly of heroin but at some point started to consume it along with cocaine, which made polyconsumption of both substances the reason for demanding treatment. All of the polysubstance users had a minimum abstinence

duration of 15 days before testing, although the mean duration of abstinence in the group was 23.79 (S.D. = 18.19) weeks, so that it was possible to rule out the presence of alterations associated with the acute or short term effects of the drugs. None of them were following methadone maintenance treatment or any other pharmacological substitution treatment during the course of the neuropsychological testing. Urine analyses for cannabis, benzodiazepines, cocaine, and heroin metabolites were conducted to confirm abstinence. Potential participants who had previously been diagnosed with any disorder from DSM-IV Axes I and II (other than substance dependence) were not included in the target sample. Those potential participants who had been previously diagnosed with traumatic brain injury, neurological disorders or HIV were also excluded.

Control participants were selected by means of local advertisements and snowball communication among adult people from the community. Selection criteria for these control 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 Central Nervous System. The mean amount of alcohol use in control participants was 35.91 units/month (S.D. = 71.82) and the mean of alcohol duration consumption was 7.79 years (S.D. = 7.63).

2.2. Instruments and assessment procedures

2.2.1. Background information

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-García et al., 2005a). This interview provides an estimation of monthly use of each substance (amount per month) and total duration of use of each substance (in years). The descriptive scores for these variables in the present sample are presented in Table 2.

2.2.2. Neuropsychological tests

We initially designed a battery of neuropsychological tests aimed to assess a number of aspects associated with executive functioning, including fluency, working memory, inhibition, shifting, and decision-making. After evaluating our preliminary results, we decided to add to this battery a number of tests originally designed to enhance the ecological validity of executive functions assessment, including complex planning and multi-tasking tasks (e.g., the BADS and the Revised Strategy Application Test). In this report we include results from both the initial and the extended battery; therefore, the number of participants vary across tests and will be stated in each case. We have not included results from the decision-making test (the Iowa Gambling Task); previous studies have shown that this test is poorly performed by roughly 15% of the healthy population (Bechara et al., 2001), and therefore is inadequate to estimate prevalence of

Table 1

Descriptive scores for the socio-demographic characteristics of poly-substance-dependent individuals (PSD) and controls (CON).

Socio-demographic variables			PSD		CON		t/chi-square ^{a,b}	p
			Mean	S.D.	Mean	S.D.		
Age			31.05	7.73	30.11	8.48	0.77 ^a	0.442
Educational level (%)	Primary		7.8		1.5		3.57 ^b	0.167
	Secondary		74.2		76.1			
	Superior		18		22.4			
Gender (%)	Men		89.4		88.05		0.08 ^b	0.811
	Women		10.6		11.95			

^a value of Student's *t*;

^b value of Chi-square χ^2 .

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