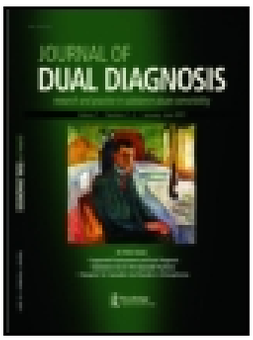

Taylor & Francis
Taylor & Francis Group

Journal of Dual Diagnosis
research and practice in substance abuse comorbidity

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/wjdd20

Impairments in Executive Functioning in Patients with Comorbid Substance Use and Personality Disorders: A Systematic Review

Enrique Moraleda-Barreno , María del Pilar Cáceres Pachón , Óscar M. Lozano , Pedro J. Pérez Moreno , José Andrés Lorca Marín , Fermín Fernández-Calderón , Carmen Díaz Batanero & Jesús Gómez-Bujedo

To cite this article: Enrique Moraleda-Barreno , María del Pilar Cáceres Pachón , Óscar M. Lozano , Pedro J. Pérez Moreno , José Andrés Lorca Marín , Fermín Fernández-Calderón , Carmen Díaz Batanero & Jesús Gómez-Bujedo (2020): Impairments in Executive Functioning in Patients with Comorbid Substance Use and Personality Disorders: A Systematic Review, Journal of Dual Diagnosis, DOI: 10.1080/15504263.2020.1829769

To link to this article: https://doi.org/10.1080/15504263.2020.1829769

JOURNAL OF DUAL DIAGNOSIS
https://doi.org/10.1080/15504263.2020.1829769

Taylor & Francis
Taylor & Francis Group

Impairments in Executive Functioning in Patients with Comorbid Substance Use and Personality Disorders: A Systematic Review

Enrique Moraleda-Barreno, PhD[a,b], María del Pilar Cáceres Pachón, MSc[c], Óscar M. Lozano, PhD[a,b], Pedro J. Pérez Moreno, PhD[a,b], José Andrés Lorca Marín, PhD[a,b], Fermín Fernández-Calderón, PhD[a,b], Carmen Díaz Batanero, PhD[a,b], and Jesús Gómez-Bujedo, PhD[a]

[a]Department of Clinical and Experimental Psychology, University of Huelva, Huelva, Spain; [b]Research Center in Natural Resources, Health and the Environment, University of Huelva, Huelva, Spain; [c]Residential Rehabilitation Center, FEAFES – Mental Health Cáceres, Cáceres, Spain

ABSTRACT

Objective: The purpose of this systematic review was to examine the evidence for impaired executive functioning in patients diagnosed with a dual pathology of personality disorder (PD) and substance use disorder, and to identify whether differences exist in comparison to those with a single diagnosis. **Methods:** A systematic search was conducted to identify studies using measures of executive functioning in patients with PD-substance use disorder dual pathology. Sixteen studies were selected. **Results:** The results indicate that dual pathology patients with Cluster C personality disorder do not differ from controls, and that the presence of dual pathology does not influence the updating domain of executive functioning. The findings were inconclusive with regard to dual pathology patients with Cluster B personality disorders. Whilst the various studies consistently show that these patients show worse performance than the control groups, here are contradictory results with regard to whether Cluster B personality disorders add more alterations in executive functioning to those that already appear in substance use disorder. **Conclusions:** The results suggest the need for further research that more adequately controls variables such as time in treatment, medication, and sample size, whilst there is also a need to employ longitudinal designs that include more patients from Clusters A and C.

KEYWORDS

Dual pathology; substance use disorder; personality disorder; executive function; systematic review

The comorbidity of substance use disorder and other mental disorders has been widely documented (Fenton et al., 2012; Fernández-Calderón et al., 2015; Grant et al., 2016; Rosenthal et al., 2012). Personality disorders (PD) are among the most prevalent of the comorbid disorders, with rates reported to exceed 50% for antisocial personality disorder (APD) and borderline personality disorder (BPD; Trull et al., 2010, 2018; Vergés et al., 2014). The comorbidity between substance use disorder and PD has been associated with serious consequences for patients and those around them (Cavicchioli et al., 2019; Kienast et al., 2014; Langås et al., 2011). In comparison with those diagnosed with a single disorder, the clinical course of the disease has been described as being more severe in those individuals for whom both disorders are present (Fenton et al., 2012; Newton-Howes & Foulds, 2018), with more severe functional impairment (Lozano et al., 2017; Newton-Howes & Gordon, 2017), as well as increased hospitalizations (Beckwith et al., 2014) and more severe psychiatric symptoms (Thornton et al., 2012).

To date, various models have been proposed to explain this comorbidity, and there does not seem to be a single etiopathogenesis (Skodol et al., 2011; Trull et al., 2018); rather, interactions between genetic and environmental factors have been proposed. Different studies have confirmed the genetic relationships between substance use disorder and PD (Distel et al., 2012; Few et al., 2014; Gillespie et al., 2018; Long et al., 2017), whilst others have highlighted their similarities in terms of emotional instability and disinhibition (Bornovalova et al., 2005; Kotov et al., 2010, 2017; Massey et al., 2018; Winsper et al., 2016; Yücel & Lubman, 2007). Brain circuits have also been identified as being involved in both types of disorders

CONTACT Jesús Gómez Bujedo jesus.gomez@dpces.uhu.es Departamento de Psicología Clínica y Experimental, Universidad de Huelva. Campus de 'El Carmen', Avda. Fuerzas Armadas, s/n. 21071, Huelva, España.

Supplemental data for this article can be accessed at publisher's website.

(Belcher et al., 2014; Conrod & Nikolaou, 2016). In this regard, evaluation through neuropsychological tests has detected common alterations in executive functions that include a reduced ability to inhibit responses (Garcia-Villamisar et al., 2017; Lev-Ran et al., 2012; Panenka et al., 2013; Spronk et al., 2013), alterations in working memory (Baliousis, 2014; Garcia-Villamisar et al., 2017; Panenka et al., 2013; Stavro et al., 2013) and poor performance in both decision making and sensitivity to future consequences (Baldacchino et al., 2012; LeGris et al., 2012; Lev-Ran et al., 2012). Similarly, alterations in impulsivity in patients with PD have been associated with an increase in substance-associated risk behaviors (Thompson et al., 2017; Tull et al., 2011). These common cognitive impairments have led some authors to emphasize the need for an assessment to determine their importance in the development and maintenance of associated disorders (Bruijnen et al., 2019).

The results of the above studies indicate common elements between substance use disorder and PD patients. However, the comparison between patients with dual pathology (substance use disorder–PD) versus those with a single disorder has been rather less studied. In this regard, some studies have found worse executive functioning in people diagnosed with substance use disorder–PD compared to those with a single diagnosis in areas such as decision-making, updating, and inhibition (Albein-Urios, Martinez-Gonzalez, Lozano, et al., 2014; Coffey et al., 2011; Dom et al., 2006b; Malloy et al., 1990; Rubio et al., 2007). However, other studies have found no differences in executive functioning between people diagnosed with substance use disorder or PD alone and substance use disorder–PD in terms of inhibition (Dom et al., 2006a), cognitive flexibility (Malloy et al., 1990), or decision-making (Sargeant et al., 2012; Verdejo-Garcia et al., 2017). This apparent discrepancy in the literature could be due to methodological differences between the studies, such as the characteristics of the sample or the instruments used (Bornovalova et al., 2005; Maraz et al., 2016). However, the negative impact and clinical difficulty shown by dual pathology patients could be taken to indicate a different pattern of cognitive functioning in these patients. For example, some studies have demonstrated how decision-making is altered in patients with BPD (Lawrence et al., 2010; Paret et al., 2017) and this executive function has been related to lack of therapeutic adherence and relapse in patients with substance use disorder (Domínguez-Salas et al., 2016; Paret et al., 2017). Although deficits in neurocognitive functioning are one of the most studied risk factors for treatment adherence and relapse (Klein, 2020), the results are inconclusive (Adinoff et al., 2016).

To date, no reviews have been done that cover the literature comparing executive functioning of patients with substance use disorders–PD to those with a single disorder. Therefore, the aim of the present study was to conduct a systematic review of the empirical literature to determine whether patients with substance use disorder–PD show different patterns of executive functioning compared with patients with only substance use disorder or PD.

Method

Literature search and selection of studies

The systematic review was conducted through the PubMed and PsycInfo databases and was completed in March 2020 following the PRISMA guidelines (Moher et al., 2009). The PRISMA checklist is available as Supplemental Table 1. Initially, the search was conducted on the "title" and "abstract" fields including the words are listed in Table 1. A complete example of the search strategy is available as supplementary material (see Supplemental Table 2). In order to further refine the search, the following inclusion criteria were established: (1) the participants had to be in treatment for substance use; (2) the patients had to be diagnosed according to Diagnostic and Statistical Manual of Mental Disorders (DSM) or International Classification of Diseases (ICD) diagnostic criteria; (3) the studies had to include at least one group of patients with dual pathology PD–substance use disorder, plus a comparative group: substance use disorder only, PD only, or healthy controls; (4) the evaluation of the patients had to include the assessment of some form of executive functioning according to the proposal of Fernández-Serrano, Pérez-García, and Verdejo-García (Fernandez-Serrano et al., 2011) and using quantitative measures such as mean differences.

The flow chart of the search process is shown in Figure 1. As can be observed, the combinations of the different keywords revealed a total of 599 studies. After excluding duplicate articles ($n = 104$), the titles and abstracts of the remaining 493 papers were reviewed. The review of the abstracts led to the exclusion of 457 articles, which did not meet the inclusion criteria. Subsequently, the full text of the 34 selected studies was evaluated, excluding 20 articles for the following reasons: the neuropsychological assessments were not considered to measure executive functions

Table 1. Terms Used in the Literature Search.

Related to drug consumption	Related to measures of executive functioning	Related to mental disorders
Cocaine	Decision making	Dual pathology
Heroin	Cognitive	Personality disorder*
Opiate	Exec* function*	Comorb*
Alcohol	Neurop*	Dual diagnos*
Methamphetamine	Neurocog*	Axis II
Cannabis	Impulsiv*	Antisocial personality disorder
Marijuana		Avoidant personality disorder
MDMA		Borderline personality disorder
Ecstasy		Narcissistic personality disorder
Polydrug		Obsessive–compulsive personality disorder
Polysubstance		Schizotypal personality disorder
Drug dependence		Schizoid personality disorder
Substance dependence		Paranoid personality disorder
Substance use disorder		
Substance use		

Note. MDMA = 3,4-Methylenedioxymethamphetamine; * = wildcard character.

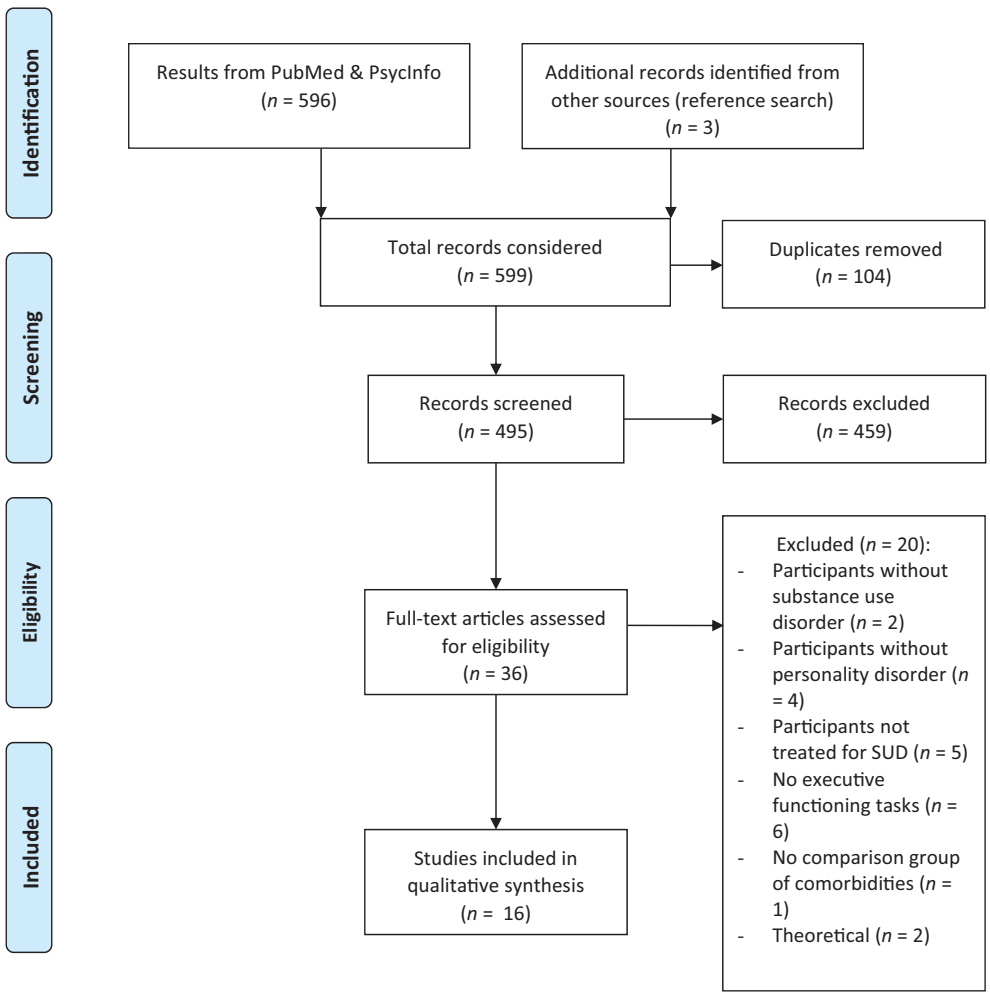

Figure 1. Flow diagram according to PRISMA guidelines.

according to the inclusion criteria ($n = 6$); they did not specify the criteria used to diagnose substance use disorder ($n = 2$) or personality disorder ($n = 4$); the sample of participants were not in treatment ($n = 5$); they did not have comparison groups ($n = 1$); or they were not empirical studies ($n = 2$).

Table 2. Description of the Studies ($n = 16$).

Study	Country	Sample Size	Substance evaluated	Personality disorder	Gender	Age (years) [mean (*SD*)]	Treatment method	Abstinence	Neuropsychological tasks
Malloy et al. (1989)	USA	182 146 AUD 36 AUD-APD	Alcohol	Antisocial Personality Disorder	AUD: NA AUD–APD: 99% males; mean age 32.1 years (7.3)	AUD: 40.2 (12.7) AUD–APD: 32.1 (7.3)	Outpatient treatment	>21 days	1. Digit-symbol Substitution Test 2. Block Design Test 3. Category Test 4. Tactual Performance Test 5. Trail Making Test (Part B)
Malloy et al. (1990)	USA	60 30 AUD 30 AUD-APD	Alcohol	Antisocial Personality Disorder	1% males	32 (NA)	Outpatient treatment	>21 days	1. Digit-symbol Substitution Test 2. Block Design Test 3. Category Test 4. Tactual Performance Test 5. Trail Making Test (Part B)
Moeller et al. (2002)	USA	74 30 CUD 19 CUD-APD 25 GC	Cocaine	Antisocial Personality Disorder	CUD: 87% males CUD–APD: 79% males	CUD: 36.5 (1.41) CUD–APD: 34.0 (1.77)	Residential & outpatient treatment	ND	1. Delayed reward task
Dom et al. (2006 a)	Belgium	133 38 AUD 23 AUD-B 19 AUD-A/C 53 GC	Alcohol	Cluster A, B & C	AUD: 74% males AUD-B: 65% males AUD-A/C: 74% males GC: 49% males	AUD: 43 (11) AUD-B: 40 (7) AUD-A/C: 41 (11) GC: : 41 (11)	Residential treatment	4–5 weeks	1. Iowa Gambling Task (IGT)
Dom et al. (2006a, 2006b)	Belgium	62 40 AUD 22 AUD-B	Alcohol	Cluster B	71% males	42.1 (9.5)	Residential treatment	>3 weeks	1. Go-No/Go task 2. Color and word test (STROOP) 3. Delay Discounting Task (DDT)
Rubio et al. (2007)	Spain	343 178 AUD 29 AUD–BPD 40 AUD–APD 96 GC	Alcohol	Cluster B: Borderline Personality Disorder Antisocial Personality Disorder	AUD: 100% males AUD–BPD: 100% males AUD–APD: 100% males GC: NA	AUD: 41.4 (8.1) AUD–BPD: 37.0 (7.2) AUD–APD: 38.0 (6.5) GC: 38.9 (6.8)	Residential & outpatient treatment	4-6 weeks	1. Stop Signal Task 2. Delay Discounting Task (DDT)
Coffey et al. (2011)	USA	79 19 BPD 32 BPD-substance use disorder 28 GC	NA	Borderline Personality Disorder	BPD: 26% males BPD-substance use disorder: 25% males GC: 7% males	BPD: 32.84 (10.85) BPD-substance use disorder: 37.34 (9.14) GC: 33.46 (12.94)	Residential treatment	> 4 days	1. Delay Discounting Task (DDT) 2. Stop Signal Task
Sargeant et al. (2012)	USA	117 77 substance use disorder 40 substance use disorder-APD	Substance use disorder	Antisocial Personality Disorder	Substance use disorder: 70.7% males substance use disorder-APD: 59.5% males	Substance use disorder: 41.8 (8.9) substance use disorder-APD: 41.9% (8.9)	Residential treatment	NA	1. Delay-Discounting Questionnaire (DDQ)

Mellentin et al. (2013)	Denmark	63 30 substance use disorder 16 substance use disorder-APD 17 GC	Substance use disorder	Antisocial Personality Disorder	76% males	Substance use disorder/ substance use disorder–APD: 35.1 (8.2) GC: 36.7 (10.6)	Outpatient treatment	NA	1. Iowa Gambling Task (IGT)
Albein-Urios et al. (2013)	Spain	110 44 CUD 32 CUD-B 34 GC	Cocaine	Cluster B	NA	CUD: 31.28 (6.5) CUD-B: 33.13 (7.7) GC: 30.5 (4.3)	Outpatient treatment	>15 days	1. Letter and number sequence tests 2. N-back task 3. Color and word tests (STROOP) 4. Category Test
Albein-Urios, Martinez-González, Lozano, et al. (2014	Spain	107 36 CUD 22 CUD-B 15 CUD-C 34 GC	Cocaine	Cluster B & C	CUD: 94.4% males CUD-B: 63.7% males CUD-C: 100% males GC: 94.4% males	CUD: 32.09 (6.3) CUD-B: 33.43 (7.2) CUD-C: 33.57 (5.8) GC: 30.5 (4.39)	Outpatient treatment	>15 days	1. Letter and number sequence tests 2. N-back task 3. Color and word tests (STROOP) 4. Category Test 5. D2 cancelation test
Albein-Urios, Pilatti, et al. (2014	Spain	96 32 CUD 38 CUD-B 26 GD	Cocaine	Cluster B	NA	Age range 18–50 years	Outpatient treatment	>15 days	1. Color and word tests (STROOP) 2. D2 cancelation test
Albein-Urios, Martinez-Gonzalez, Lozano-Rojas, et al. (2014	Spain	152 32 CUD 23 CUD-B 15 CUD-C 14 GD 36 GC	Cocaine	Cluster B & C	NA	Age range 19–52 years	Outpatient treatment	>15 days	1. Delay-Discounting Questionnaire (DDQ)
Moody et al. (2016)	USA	327 166 substance use disorder 44 substance use disorder-TD 35 substance use disorder-APD 22 substance use disorder-MDD-APD 60 GC	Substance use disorder	Antisocial Personality Disorder	Substance use disorder: 75.9% males substance use disorder–MDD: 81.8% males substance use disorder–APD: 77.1% males substance use disorder-MDD–APD: 86.4% males GC: 61.7% males	Substance use disorder: 43.05 (10.35) substance use disorder–MDD: 45.61 (9.71) substance use disorder-APD: 40.57 (9.91) substance use disorder-MDD–APD: 43.00 (11.04) GC: 35.15 (13.48)	Outpatient treatment	NA	1. Delay Discounting Task (DDT)
Maraz et al. (2016)	Hungary	345 101 AUD 23 substance use disorder 36 BPD 49 AUD-BPD 25 substance use disorder-BPD 111 GC	Alcohol substance use disorder	Borderline Personality Disorder	AUD: 81.2% males substance use disorder: 56.5% males BPD: 11.1% males BPD-AUD: 62.5% males BPD-substance use disorder: 60% males GC: 39.6% males	AUD: 48.3 (9.5) substance use disorder: 31.4 (10.0) BPD: 30.6 (10.8) BPD-AUD: 40.1 (8.9) BPD-substance use disorder: 29.5 (10.2) GC: 36.6 (11.0)	Outpatient treatment	>24 h	1. Delay Discounting Task (DDT)

(*Continued*)

Table 2. Continued.

Study	Country	Sample Size	Substance evaluated	Personality disorder	Gender	Age (years) [mean (*SD*)]	Treatment method	Abstinence	Neuropsychological tasks
Verdejo-García et al. (2017)	Spain	62 19 CUD 24 CUD–PD 19 GC	Cocaine	Cluster B & C	CUD: 94.7% males CUD-TP: 83.3% males GC: 94.7% males	CUD: 35.42 (6.38) CUD-PD: 33.21 (7.00) GC: 30.84 (4.13)	Outpatient treatment	>15 days	1. fMRI task: Ultimatum Game (UG)

Note. CUD = group diagnosed with cocaine use disorder without comorbidity; CUD-B = group diagnosed with cocaine use disorder and Cluster B personality disorder; CUD-C = group diagnosed with cocaine use disorder and Cluster C personality disorder; CUD–APD = group diagnosed with cocaine disorder and antisocial personality disorder; CUD-PD = group diagnosed with cocaine use disorder and personality disorder; *SD* = standard deviation; GC = group control; AUD = group diagnosed with alcohol use disorder without comorbidity; AUD-A/C = group diagnosed with alcohol use disorder and Cluster A and C personality disorders; AUD-B = group diagnosed with alcohol use disorder and Cluster B personality disorder; AUD–BZD = group diagnosed with alcohol use disorder and benzodiazepine use disorder; AUD–BZD–PD = group diagnosed with alcohol use disorder, benzodiazepine use disorder, and personality disorder; AUD–APD = group diagnosed with alcohol use disorder and antisocial personality disorder; AUD–PD = group diagnosed with alcohol use disorder and personality disorder; AUD–BPD = group diagnosed with alcohol use disorder and borderline personality disorder; NA = not available; substance use disorder = group diagnosed with substance use disorder without comorbidity; substance use disorder-APD = group diagnosed with substance use disorder and antisocial personality disorder; substance use disorder–MDD = group diagnosed with both substance use disorder and depression; substance use disorder–MDD–APD = group diagnosed with substance use disorder, depression, and antisocial personality disorder; substance use disorder–BPD = group diagnosed with substance use disorder and borderline personality disorder; GD = group diagnosed with pathological gambling disorder without comorbidity; BPD = group diagnosed with borderline personality disorder without comorbidity; MDD = group diagnosed with major depressive disorder.

Moreover, two studies identified in the references of the reviewed articles were included. A total of 16 studies were included in the review.

Classification of tests used to measure executive functioning

To categorize the tests of executive functioning, we decided to use the classification system established by Fernandez-Serrano et al. (2011). This classification provides a definition of each neuropsychological domain, along with a list of the most commonly used tests for measuring them. This classification considers the following domains of executive functioning: updating, cognitive flexibility, inhibition, decision-making, planning, organization, and sequencing.

Results

Description of the studies

Table 2 describes the characteristics of the 16 selected studies. Most of these ($n = 10$) were conducted in Europe (Spain, Belgium, Hungary, and Denmark), while the remaining six were conducted in the United States. The period of publication of these studies is from 1989 to 2017. With respect to the substance for which treatment was needed, six of the studies included patients with cocaine-related problems, and five studies included patients with alcohol-related problems. However, almost one third of the studies ($n = 5$) do not specify the particular substances for which the participants were being treated, instead using the category "substance use disorder." Most studies ($n = 11$) assessed patients with Cluster B personality disorders, while the remaining studies included patients diagnosed with personality disorders from Clusters C and A.

The total sample size of the reviewed studies ranged from 60 (Malloy et al., 1990) to 345 (Maraz et al., 2016). Group size ranged from 14 (Albein-Urios, Martinez-González, Lozano, et al., 2014) to 178 (Rubio et al., 2007). In most studies ($n = 10$) the patients were treated on an outpatient basis and in four studies the patients received residential treatment ($n = 4$), while two studies evaluated patients that received both treatment modalities. With regard to abstinence prior to neuropsychological assessment, these periods ranged from 2 days to 6 weeks, with a period of longer than 15 days in most of the studies reviewed ($n = 10$). Four studies did not provide data on the period of abstinence prior to assessment. All of the studies employed a cross-sectional design.

Table 3. Main Results and/or Conclusions of the Selected Studies Organized According to Domains.

Domain	Substance	Personality disorder	Sample size	Study	Main results and/or conclusions
Updated					
Analogical Reasoning	Alcohol	Antisocial Personality Disorder	182 146 AUD 36 AUD-APD	Malloy et al. (1989)	No statistically significant differences were found between the groups with and without dual pathology on the Category Test
			60 30 AUD 30 AUD–APD	Malloy et al. (1990)	No statistically significant differences were found between the groups with and without dual pathology on the Category Test
	Cocaine	Cluster B & C	107 36 CUD 22 CUD-B 15 CUD-C 34 GC	Albein-Urios, Martinez-González, Lozano, et al. (2014)	No statistically significant differences were found between the groups with and without dual pathology on the Category Test. No statistically significant differences were found between Clusters B and C of the dual pathology groups
		Cluster B	110 44 CUD 32 CUD-B 34 GC	Albein-Urios et al. (2013)	No statistically significant differences were found between the groups with and without dual pathology on the Category Test. The control group showed better performance than the dual-pathology patients with Cluster B personality disorder ($d = 0.89$) and those with cocaine use disorder only ($d = 0.59$)
Working Memory	Cocaine	Cluster B & C	107 36 CUD 22 CUD-B 15 CUD-C 34 GC	Albein-Urios, Martinez-Gonzalez, Lozano, et al. (2014)	No statistically significant differences were found in performance on the letter and number sequence test between groups with and without dual pathology or between Cluster B and C patients. The group of cocaine users without dual pathology and the cocaine users with Cluster C personality disorder showed greater deficits in working memory compared with the control group ($d = 1.0$ and $d = 1.1$, respectively)
		Cluster B	110 44 CUD 32 CUD-B 34 GC	Albein-Urios et al. (2013)	The groups with and without dual pathology did not differ in terms of their performance on the letter-number sequence test. The control group differed significantly from the group with dual pathology ($d = 0.88$) and the group of cocaine dependent patients without dual pathology ($d = 1.06$)
Cognitive Flexibility					
Changing Criterion	Alcohol	Antisocial Personality Disorder	182 146 AUD 36 AUD-APD	Malloy et al. (1989)	The dual pathology group showed poorer performance than the non-dual group on the symbol and digit test ($F = 8.06$, 1/179 df, $p<.01$), but no significant differences were found on the Trail Making Test (Part B) or the tactual performance test
			60 30 AUD 30 AUD-APD	Malloy et al. (1990)	No statistically significant differences were found between the groups on either the symbol and digit test or the tactual performance test, but the APD group showed poorer performance on the Trail Making Test ($t = 2.01$, $p < .05$)
Inhibition					
Impulsive Action	Alcohol	Cluster B	62 40 AUD 22 AUD-B	Dom et al. (2006a, 2006b)	No statistically significant differences were found between the groups with and without dual pathology in the color and word test (Stroop). However, the dual pathology group showed significantly lower inhibitory control in comparison with the alcohol group without dual pathology in the Go-No/Go task ($F = 4.062$, $p < .05$)
			343 178 AUD 29 AUD-BPD 40 AUD-APD 96 GC	Rubio et al. (2007)	Using the Stop-signal task, the groups with dual antisocial and borderline pathology showed greater deficits in inhibition compared with the control group and the alcohol group without pathology ($F = 6.68$; df = 341, $p = .001$) However, the dual-pathology groups did not differ significantly from either the control group or the alcohol group

(*Continued*)

Table 3. Continued.

Domain	Substance	Personality disorder	Sample size	Study	Main results and/or conclusions
	Cocaine	Cluster B & C	96 32 CUD 38 CUD-B 26 GD	Albein-Urios, Pilatti, et al. (2014)	No significant differences were found on the response inhibition tests (Stroop and D2 cancelation test) between the groups with and without dual pathology
			107 36 CUD 22 CUD-B 15 CUD-C 34 GC	Albein-Urios, Martinez-Gonzalez, Lozano, et al. (2014)	There were no statistically significant differences between the dual-pathology groups and the group without comorbidity, or between the two dual-pathology groups. The cocaine-dependent group with Cluster B personality disorder showed poorer behavioral inhibition compared with controls, on both the Stroop test ($d = 0.7$) and the D2 cancelation test ($d = 1.0$)
		Cluster B	110 44 CUD 32 CUD-B 34 GC	Albein-Urios et al. (2013)	The group with dual pathology had significantly performed significantly worse on the task in comparison with the group of cocaine users, on both the Stroop test ($d = 0.5$) and the D2 cancelation test ($d = 0.79$). The groups with and without dual pathology showed greater deficits in response inhibition when compared with the control group (D2, $d = 1.05$; Stroop, $d = 0.79$)
	Substance use disorder (NA)	Borderline Personality Disorder	79 19 BPD 32 BPD–substance use disorder 28 GC	Coffey et al. (2011)	No statistically significant differences were found between the two groups with BPD. The two groups with BPD showed poorer behavioral inhibition than the control group on the Stop-signal task (BPD versus GC: $d = 1.26$; BPD-substance use disorder versus GC: $d = 0.90$
Impulsive Choice	Alcohol	Cluster B	62 40 AUD 22 AUD-B	Dom et al. (2006a, 2006b)	The ability to delay rewards did not differ between the two groups ($F = 0.285$)
			343 178 AUD 29 AUD–BPD 40 AUD–APD 96 GC	Rubio et al. (2007)	Statistically significant differences were found between all groups, with the deterioration being greatest among patients with antisocial personality disorder, followed by the borderline disorder group, the alcohol use group without Cluster B disorder, and finally the control group ($F = 11.31$)
	Cocaine	Cluster B & C	152 32 CUD 23 CUD-B 15 CUD-C 14 GD 36 GC	Albein-Urios, Martinez-Gonzalez, Lozano-Rojas, et al. (2014)	No significant differences were observed between the cocaine groups with and without comorbidity, or between these groups and the control group
		Antisocial Personality Disorder	74 30 CUD 19 CUD–APD 25 GC	Moeller et al. (2002)	No statistically significant differences were found between the two groups with substance use disorder. Regardless of the presence of antisocial personality disorder, cocaine-dependent subjects showed more impulsive behavior during the tasks compared with the control group ($F = 3.64$)
	Substance use disorder	Antisocial Personality Disorder	327 166 substance use disorder 44 substance use disorder-MDD 35 substance use disorder-APD 22 substance use disorder-MDD–APD 60 GC	Moody et al. (2016)	People with APD and substance use disorder, and people with MDD, APD and substance use disorder discounted future rewards significantly more than substance users without comorbid psychopathology ($d = 0.412$ and $d = 0.964$, respectively). All groups with substance use disorder exhibited significantly more impulsive behavior than healthy controls

			117 77 substance use disorder 40 substance use disorder-APD	Sargeant et al. (2012)	For this domain, no statistically significant differences were found between the groups with and without dual pathology
		Borderline Personality Disorder	345 101 AUD 23 substance use disorder 36 BPD 49 AUD–BPD 25 substance use disorder-BPD 111 GC	Maraz et al. (2016)	The group with alcohol use disorder plus BPD showed greater delay discounting impulsivity than the group with alcohol use disorder alone ($p < .05$). There were statistically significant differences between the control group and the groups with BPD plus substance use disorder (d=0.86), and BPD plus alcohol use disorder ($d = 0.61$). No statistically significant differences were found between the rest of the groups
			79 19 BPD 32 BPD-substance use disorder 28 GC	Coffey et al. (2011)	The dual pathology group showed greater inability to delay reward compared with the control group ($d = 0.66$). However, no significant differences were found between the rest of the groups
Decision-making					
	Alcohol	Cluster A, B & C	133 38 AUD 23 AUD-B 19 AUD-A/C 53 GC	Dom et al. (2006a)	The group of alcohol users with Cluster B personality disorder showed the poorest performance on the IGT compared with the alcohol users with Cluster A or C personality disorder, and the alcohol group without dual pathology, F (2, 79)=3.230; $p = .045$. Regardless of the presence of personality disorder, the alcohol drinking groups with and without dual pathology showed more impulsive decision-making compared with the control group
	Cocaine	Cluster B & C	62 19 CUD 24 CUD–PD 19 GC	Verdejo-García et al. (2017)	No significant group differences were found for either the Ultimatum Game task or for brain activation. The cocaine group with dual pathology showed less connectivity of the brain regions involved in the emotional processing of the task
	Substance use disorder	Antisocial Personality Disorder	63 30 substance use disorder 16 substance use disorder-APD 17 GC	Mellentin et al. (2013)	The presence of antisocial personality disorder was not associated with poorer IGT performance in participants with substance use disorder. Greater impairment on task performance was found in the groups with and without dual pathology in comparison with the control group ($d = 1.01$ and $d = 1.43$, respectively)
Planning, organizing, and sequencing					
	Alcohol	Antisocial Personality Disorder	182 146 AUD 36 AUD–APD	Malloy et al. (1989)	The results revealed no differences between the groups with and without antisocial personality disorder
			60 30 AUD 30 AUD–APD	Malloy et al. (1990)	The group of patients with dual pathology showed significantly worse performance compared with the group without dual pathology, t(58)=1.97

Note. CUD = group diagnosed with cocaine use disorder without comorbidity; CUD-B = group diagnosed with cocaine use disorder and Cluster B personality disorder; CUD-C = group diagnosed with cocaine use disorder and Cluster C personality disorder; CUD–APD = group diagnosed with cocaine disorder and antisocial personality disorder; CUD–PD = group diagnosed with cocaine use disorder and personality disorder; *SD* = standard deviation; GC = group control; AUD = group diagnosed with alcohol use disorder without comorbidity; AUD-A/C = group diagnosed with alcohol use disorder and Cluster A and C personality disorders; AUD-B = group diagnosed with alcohol use disorder and Cluster B personality disorder; AUD–BZD = group diagnosed with alcohol use disorder and benzodiazepine use disorder; AUD–BZD–PD = group diagnosed with alcohol use disorder, benzodiazepine use disorder, and personality disorder; AUD–APD = group diagnosed with alcohol use disorder and antisocial personality disorder; AUD–PD = group diagnosed with alcohol use disorder and personality disorder; AUD–BPD = group diagnosed with alcohol use disorder and borderline personality disorder; NA = not available; substance use disorder: group diagnosed with substance use disorder without comorbidity; substance use disorder–APD = group diagnosed with substance use disorder and antisocial personality disorder; substance use disorder–MDD = group diagnosed with both substance use disorder and depression; substance use disorder–MDD–APD = group diagnosed with substance use disorder, depression, and antisocial personality disorder; substance use disorder–BPD = group diagnosed with substance use disorder and borderline personality disorder; GD = group diagnosed with pathological gambling disorder without comorbidity; BPD = group diagnosed with borderline personality disorder without comorbidity.

Comparisons for the cognitive updating domain

This cognitive domain, updating, has been studied in four articles, none of which report differences between groups with and without dual pathology, or between dual pathologies with different personality disorders. Two of the studies exclusively analyzed analogical reasoning in patients with alcohol use disorder (AUD) and found no differences between the comorbid group diagnosed with APD, and the group without comorbidity (Malloy et al., 1989, 1990). Two other studies concluded that, regardless of the presence of Cluster B or C personality disorder, patients with cocaine use disorder (CUD) performed worse on both analogical reasoning and working memory tasks when compared with controls (Albein-Urios et al., 2013; Albein-Urios, Martinez-Gonzalez, Lozano-Rojas, et al., 2014).

Comparisons for the cognitive flexibility domain

Two studies investigated the performance on cognitive flexibility tasks of AUD patients with and without APD using the subtests Trail Making Test, Digit and Symbol Test, and the tactual performance test from the Brain Age Quotient (BAQ) Battery. One of the studies found that the dual pathology group showed worse performance on the Trail Making Test (Malloy et al., 1990) whilst another found that this group performed worse on the Digit and Symbol Test (Malloy et al., 1989), with no differences on the rest of the tests.

Comparisons for the cognitive inhibition domain

For the inhibition domain, mixed results are found when comparing substance use disorder–PD and substance use disorder patients. Most papers ($n = 11$) compare results in the inhibition domain in patients with Cluster B personality disorder. Three studies have used different tasks to measure the construct (Table 3).

Seven papers addressed impulsive action. In three of these, patients diagnosed with substance use disorder–PD from Cluster B showed greater deficits compared with patients with AUD (Dom et al., 2006a; Rubio et al., 2007) and CUD (Albein-Urios et al., 2013). Four others found no such differences in studies with CUD (Albein-Urios, Martinez-Gonzalez, Lozano-Rojas, et al., 2014; Albein-Urios, Pilatti, et al., 2014; Coffey et al., 2011; Dom et al., 2006a). In comparison with the control group, four articles report that patients with dual pathology in Cluster B had worse outcomes than patients with AUD (Rubio et al., 2007), CUD (Albein-Urios et al., 2013; Albein-Urios, Martinez-Gonzalez, Lozano-Rojas, et al., 2014), and substance use disorder (Coffey et al., 2011). Of these, the two studies that analyzed the differences between non-dual pathology drug users and controls also found that the former showed more deficits (Albein-Urios et al., 2013; Coffey et al., 2011).

With regard to impulsive choice, there are eight studies reporting discrepant results when comparing the performance of dual pathology patients with Cluster B personality disorder with substance use disorder-only patients. While three of these studies found worse performance in the groups with dual pathology Cluster B in alcohol (Rubio et al., 2007) or other substance use disorder (Maraz et al., 2016; Moody et al., 2016), five other studies did find these differences in either alcohol (Dom et al., 2006a), cocaine (Albein-Urios, Martinez-González, Lozano, et al., 2014; Moeller et al., 2002), or other substance use disorder (Coffey et al., 2011; Sargeant et al., 2012). However, five studies compared control groups with dual pathology Cluster B patients, and all reported performance in the latter groups regardless of whether they used alcohol (Rubio et al., 2007), cocaine (Moeller et al., 2002), or other substances (Coffey et al., 2011; Maraz et al., 2016; Moody et al., 2016). When analyzing the differences between the control group and the non-dual pathology groups, three studies also found these same differences (Moeller et al., 2002; Moody et al., 2016; Rubio et al., 2007), while two others did not (Coffey et al., 2011; Maraz et al., 2016).

Three studies also included dual pathology with Cluster C personality disorders in patients with cocaine or alcohol use disorders. These studies found no difference between patients with and without dual pathology (Albein-Urios, Martinez-Gonzalez, Lozano-Rojas, et al., 2014; Albein-Urios, Martinez-González, Lozano, et al., 2014; Albein-Urios, Pilatti, et al., 2014), whilst the latter groups did not differ from the control group (Albein-Urios, Pilatti, et al., 2014).

Comparisons for the decision-making domain

Three studies included tests to evaluate the decision-making domain. One of these studies found that patients with AUD and PD from Cluster B presented more alterations in performance on the Iowa Gambling Task (IGT) than those from Clusters A and C, and those with AUD only (Dom et al., 2006b). However, a study with CUD patients using the Ultimatum Game (Verdejo-Garcia et al., 2017) and another with substance use disorder patients using the IGT (Mellentin et al., 2013) found no differences between patients with and without dual pathology.

However, the two studies using the IGT found differences between patients with substance use disorder and the control group regardless of whether dual pathology was present (Dom et al., 2006b; Mellentin et al., 2013), whilst the study using the Ultimatum Game did not find such differences (Verdejo-Garcia et al., 2017).

Comparisons for the cognitive planning/organizing/sequencing domain

With regard to this domain, two studies were found, both in patients with AUD and APD. Whilst in one of the studies the dual pathology group showed significantly worse performance than the group with AUD only (Malloy et al., 1990), the other reported that the two groups behaved similarly (Malloy et al., 1989).

Discussion

The aim of this paper was to systematically review the evidence for deficits in the executive functioning of patients diagnosed with comorbid substance use and personality disorder. The results reveal that patients with dual pathology with a Cluster C personality disorder do not differ from controls, and the presence of dual pathology does not influence cognitive updating. However, the findings are inconclusive with regard to dual pathology patients with Cluster B personality disorder. Whilst the various studies consistently show that these patients present worse performance than the control groups, it is unclear as to whether Cluster B personality disorder adds more alterations in executive functions to those already observed in substance use disorder. Overall, the evidence available about the role of executive function in substance use disorder–PD is limited. The present review highlights the need to homogenize assessment instruments in executive functioning, as well as to increase the research efforts in this area and include more studies with patients from Cluster C and especially from Cluster A, since it was identified as an area for future development.

The analysis of executive functions reveals that it is in the updating domain where it is most clearly observed that the comorbidity of personality disorders with substance use disorder is not associated with a major alteration. However, for the remaining domains, discrepancies in the findings were found. Such discrepancies are observed exclusively in studies of personality disorders belonging to Cluster B, and never to those of Clusters A or C. Impulsivity and other executive function disorders are a central feature of APD (Ogilvie et al., 2011) and BPD (Mcclure et al., 2016). Therefore, it is not surprising that dual pathology patients with Cluster B personality disorders are those that show the greatest alterations. In this regard, it could be hypothesized that PDs belonging to Cluster B interact with substance use disorder, increasing the pathology related to executive functions, and causing greater difficulties in impulse control and appropriate decision making. However, the discrepancies between the results of the different studies suggest that there is no conclusive support for this hypothesis. Furthermore, the results are mixed, even among studies conducted with patients diagnosed with the same substance use disorder and using the same neuropsychological tests.

These discrepant findings do not appear in studies with patients from Cluster C. It is likely that this type of PD does not have such clear executive components. Some authors have proposed that in patients with dual pathology with disorders characterized by avoidance (such as those in Cluster C), the presence of substance use disorder could be associated with a lower tendency toward rigidity and sensation-seeking (Duijkers et al., 2016). The fact that Cluster C groups do not usually present as many differences with respect to controls as Cluster B and non-dual controls could mean that the presence of these PDs decreases the impulsive tendencies that are usually associated with substance use disorder. That is, it is possible that the presence of dual pathology with Cluster B personality disorders does not increase the impulsivity of substance use disorder patients but, rather, the presence of dual pathology with Cluster C personality disorders decreases such impulsivity. However, it should be noted that few studies include patients from this cluster, so it is not possible to confirm this hypothesis. For this same reason, it is also not possible to draw any clear conclusions on comorbidity with Cluster A personality disorders.

However, the results show that dual pathology patients with Cluster B personality disorders present more alterations in their executive functions compared with healthy controls, particularly in the domains of updating, inhibition, and decision making. In studies with patients in treatment for AUD or CUD (Fernandez-Serrano et al., 2011), these alterations appear in the absence of comorbidity, in addition to functional and structural alterations in frontal lobe neuroimaging (Bühler & Mann, 2011; Goldstein & Volkow, 2011). Therefore, the differences with respect

to control groups could be linked to addiction-related factors. Further, in many PD without comorbidity (schizotypal, borderline, antisocial, narcissistic, and obsessive–compulsive), alterations in executive functions (Garcia-Villamisar et al., 2017) and in neuroimaging (Ma et al., 2016) have also been found, but there are almost no data on the rest of the disorders. It is possible that in some cases of dual pathology such as schizotypal, obsessive–compulsive, antisocial, narcissistic, and borderline, both conditions interfere with executive functions, and in the remaining cases (schizoid, paranoid, avoidant, dependent, and histrionic) the difference observed in comparison with healthy controls are more related to substance use disorder. These results are also consistent with the daily difficulties faced by dual pathology patients in terms of decision making, inhibition of problematic behaviors, planning, and behavioral flexibility.

The results of this work have clinical implications for the treatment of dual pathology patients. There is abundant evidence to suggest that poor executive functioning is related to unfavorable treatment outcomes in addiction, including a higher rate of relapse and abandonment (Domínguez-Salas et al., 2016; Stevens et al., 2014). This implies that improving executive functioning should be one of the aims of intervention programs, and, in fact, cognitive training has been observed to improve the effectiveness of treatments (Holmes et al., 2014; Shoptaw, 2014). Therefore, this aspect of the intervention would be of special relevance for both non-dual patients and for those with comorbid personality disorders from Clusters A or B, but it would be less important for those of Cluster C, since this group does not appear to present alterations in executive functioning.

However, it should be noted that all of these studies have been conducted using the DSM-IV or DSM-*5* Section II categorical classification for PDs that include among their criteria some behaviors related to executive functioning, such as impulsivity. This diagnostic system has been shown to have a number of limitations (Widiger & Samuel, 2005), which could be, at least in part, responsible for some of the discrepant results found in the literature. Thus, it could be more productive to explore the relationship between executive functions and the alternative diagnostic model of PD in Section III of the DSM-*5*. This model is dimensional rather than categorical and is based on the measurement of pathological personality traits that include 25 facets configured in five domains (Krueger & Markon, 2014; Krueger et al., 2012). Different scores on these domains and facets are associated with the presence of different PDs (Samuel & Widiger, 2008; Saulsman & Page, 2004), so that while APD includes several other facets of the antagonistic domain, schizotypal disorder includes facets of the psychotic domain. It is likely that some of the facets that make up the different PDs will be associated with alterations in executive functions, whilst others will not (Arnevik et al., 2019). Therefore, it could be interesting to directly study the relationships between executive functions and the different facets and domains that make up the PDs.

With regard to the limitations found in this review, it is worth noting the heterogeneity of the findings reported in the various studies. This could be attributed to methodological differences between the studies, where different tasks have been employed to evaluate the same construct. Also, there were important differences in the methodological quality of the selected studies. Sample sizes varied from 60 to 345 participants, and the description of potential bias in participant flow (including recruitment, withdrawals, and dropout) was incomplete or even absent in several cases. Only one study (Dom, 2006a) included a CONSORT flowchart. The groups of interest were partially matched at best in most studies, and differences in relevant confounders such as sociodemographic variables, IQ, severity of psychiatric pathologies, and use of other drugs were reported in different studies, which should make us cautious when interpreting the differences found (or their absence). Moreover, the periods of abstinence were not the same for all studies, and four studies did not even supply such information, which could affect the results found. Finally, the sample sizes in many of the studies were relatively modest, particularly in the dual pathology groups, which could limit the possibility of generalizing the results. Also, the small number of participants in certain subgroups could explain by itself some of the negative results due to limited statistical power. Adopting clear sample size calculation strategies (Pye et al., 2016) would improve the research practice in the field.

Based on the most salient conclusions of this review, we believe that future studies in this area could benefit from using the standardized protocol for assessing executive functioning proposed by Dickinson, Becerra, and Coombes (Dickinson et al., 2017). These authors point out the importance of taking into account the following aspects when evaluating executive functioning: (a) parameters of symptom remission; (b) pharmacotherapy and condition of psychiatric comorbidity; (c) definition of executive

function; and (d) neuropsychological tests of executive function.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Database via the OVID Platform; 26 September 2018.

Funding

This work was supported by the National Drug Strategy, "Ministry of Health, Social Services and Equality" (Spain) under Grant "Q7150008F-2016/034."

ORCID

Enrique Moraleda-Barreno http://orcid.org/0000-0003-2324-6559
María del Pilar Cáceres Pachón http://orcid.org/0000-0001-6357-9652
Óscar M. Lozano http://orcid.org/0000-0003-2722-6563
Pedro J. Pérez Moreno http://orcid.org/0000-0002-6074-9385
José Andrés Lorca Marín http://orcid.org/0000-0003-0331-020X
Fermín Fernández-Calderón http://orcid.org/0000-0002-2981-1670
Carmen Díaz Batanero http://orcid.org/0000-0003-3392-4683
Jesús Gómez-Bujedo http://orcid.org/0000-0003-3074-7415

References

Adinoff, B., Carmody, T. J., Walker, R., Donovan, D. M., Brigham, G. S., & Winhusen, T. M. (2016). Decision-making processes as predictors of relapse and subsequent use in stimulant-dependent patients. *The American Journal of Drug and Alcohol Abuse*, *42*(1), 88–97. https://doi.org/10.3109/00952990.2015.1106550

Albein-Urios, N., Martinez-Gonzalez, J. M., Lozano, Ó., Moreno-López, L., Soriano-Mas, C., & Verdejo-Garcia, A. (2013). Negative urgency, disinhibition and reduced temporal pole gray matter characterize the comorbidity of cocaine dependence and personality disorders. *Drug and Alcohol Dependence*, *132*(1–2), 231–237. https://doi.org/10.1016/j.drugalcdep.2013.02.008

Albein-Urios, N., Martinez-González, J. M., Lozano, Ó., & Verdejo-Garcia, A. (2014). Monetary delay discounting in gambling and cocaine dependence with personality comorbidities. *Addictive Behaviors*, *39*(11), 1658–1662. https://doi.org/10.1016/j.addbeh.2014.06.001

Albein-Urios, N., Martinez-Gonzalez, J. M., Lozano-Rojas, O., & Verdejo-Garcia, A. (2014). Executive functions in cocaine-dependent patients with Cluster B and Cluster C personality disorders. *Neuropsychology*, *28*(1), 84–90. https://doi.org/10.1037/neu0000007

Albein-Urios, N., Pilatti, A., Lozano, O., Martínez-González, J. M., & Verdejo-García, A. (2014). The value of impulsivity to define subgroups of addicted individuals differing in personality dysfunction, craving, psychosocial adjustment, and wellbeing: A latent class analysis. *Archives of Clinical Neuropsychology*, *29*(1), 38–46. https://doi.org/10.1093/arclin/act072

Arnevik, E. A., Pedersen, G., Walderhaug, E., Lien, I., Wilberg, T., & Hummelen, B. (2019). Measuring personality problems in patients with substance use disorders: A cross-sample validation. *Journal of Dual Diagnosis*, *15*(4), 324–332. https://doi.org/10.1080/15504263.2019.1668583

Baldacchino, A., Balfour, D., Passetti, F., Humphris, G., & Matthews, K. (2012). Neuropsychological consequences of chronic opioid use: A quantitative review and meta-analysis. *Neuroscience and Biobehavioral Reviews*, *36*(9), 2056–2068. https://doi.org/10.1016/j.neubiorev.2012.06.006

Baliousis, M. (2014). *Neuropsychological deficits in the antisocial personality and their relationship to progress in treatment* [Doctoral dissertation]. University of Nottingham.

Beckwith, H., Moran, P. F., & Reilly, J. (2014). Personality disorder prevalence in psychiatric outpatients: A systematic literature review. *Personality and Mental Health*, *8*(2), 91–101. https://doi.org/10.1002/pmh.1252

Belcher, A. M., Volkow, N. D., Moeller, F. G., & Ferré, S. (2014). Personality traits and vulnerability or resilience to substance use disorders. *Trends in Cognitive Sciences*, *18*(4), 211–217. https://doi.org/10.1016/j.tics.2014.01.010

Bornovalova, M. A., Lejuez, C., Daughters, S. B., Rosenthal, M. Z., & Lynch, T. R. (2005). Impulsivity as a common process across borderline personality and substance use disorders. *Clinical Psychology Review*, *25*(6), 790–812. https://doi.org/10.1016/j.cpr.2005.05.005

Bruijnen, C. J., Dijkstra, B. A., Walvoort, S. J., Markus, W., VanDerNagel, J. E., Kessels, R. P., & De Jong, C. A. (2019). Prevalence of cognitive impairment in patients with substance use disorder. *Drug and Alcohol Review*, *38*(4), 435–442. https://doi.org/10.1111/dar.12922

Bühler, M., & Mann, K. (2011). Alcohol and the human brain: A systematic review of different neuroimaging methods. *Alcoholism, Clinical and Experimental Research*, *35*(10), 1771–1793. https://doi.org/10.1111/j.1530-0277.2011.01540.x

Cavicchioli, M., Prudenziati, F., Movalli, M., Ramella, P., & Maffei, C. (2019). The severity of personality pathology: A risk factor for concurrent substance use disorders in alcohol use disorder. *Journal of Dual Diagnosis*, *15*(3), 159–171. https://doi.org/10.1080/15504263.2019.1612131

Coffey, S. F., Schumacher, J. A., Baschnagel, J. S., Hawk, L. W., & Holloman, G. (2011). Impulsivity and risk-taking in borderline personality disorder with and without substance use disorders. *Personality Disorders*, *2*(2), 128–141. https://doi.org/10.1037/a0020574

Conrod, P. J., & Nikolaou, K. (2016). Annual research review: On the developmental neuropsychology of substance use disorders. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *57*(3), 371–394. https://doi.org/10.1111/jcpp.12516

Dickinson, T., Becerra, R., & Coombes, J. (2017). Executive functioning deficits among adults with bipolar disorder (types I and II): A systematic review and meta-analysis. *Journal of Affective Disorders*, *218*, 407–427. https://doi.org/10.1016/j.jad.2017.04.010

Distel, M. A., Trull, T. J., de Moor, M. M. H., Vink, J. M., Geels, L. M., van Beek, J. H. D. A., Bartels, M., Willemsen, G., Thiery, E., Derom, C. A., Neale, M. C., & Boomsma, D. I. (2012). Borderline personality traits and substance use: Genetic factors underlie the association with smoking and ever use of cannabis, but not with high alcohol consumption. *Journal of Personality Disorders*, *26*(6), 867–879. https://doi.org/10.1521/pedi.2012.26.6.867

Dom, G., De Wilde, B., Hulstijn, W., Van Den Brink, W., & Sabbe, B. (2006a). Behavioural aspects of impulsivity in alcoholics with and without a cluster-B personality disorder. *Alcohol and Alcoholism*, *41*(4), 412–420. https://doi.org/alclac/agl030

Dom, G., De Wilde, B., Hulstijn, W., Van Den Brink, W., & Sabbe, B. (2006b). Decision-making deficits in alcohol-dependent patients with and without comorbid personality disorder. *Alcoholism, Clinical and Experimental Research*, *30*(10), 1670–1677. https://doi.org/10.1111/j.1530-0277.2006.00202.x

Domínguez-Salas, S., Díaz-Batanero, C., Lozano-Rojas, O. M., & Verdejo-García, A. (2016). Impact of general cognition and executive function deficits on addiction treatment outcomes: Systematic review and discussion of neurocognitive pathways. *Neuroscience and Biobehavioral Reviews*, *71*, 772–801. https://doi.org/10.1016/j.neubiorev.2016.09.030

Duijkers, J. C. L. M., Vissers, C. T. W. M., & Egger, J. I. M. (2016). Unraveling executive functioning in dual diagnosis. *Frontiers in Psychology*, *7*, 979. https://doi.org/10.3389/fpsyg.2016.00979

Fenton, M. C., Keyes, K., Geier, T., Greenstein, E., Skodol, A., Krueger, B., Grant, B. F., & Hasin, D. S. (2012). Psychiatric comorbidity and the persistence of drug use disorders in the United States. *Addiction*, *107*(3), 599–609. https://doi.org/10.1111/j.1360-0443.2011.03638.x

Fernández-Calderón, D., Fernández, F., Ruiz-Curado, S., Verdejo-García, A., & Lozano, Ó. M. (2015). Profiles of substance use disorders in patients of therapeutic communities: Link to social, medical and psychiatric characteristics. *Drug and Alcohol Dependence*, *149*, 31–39. https://doi.org/10.1016/j.drugalcdep.2015.01.013

Fernandez-Serrano, M. J., Pérez-García, M., & Verdejo-García, A. (2011). What are the specific vs. generalized effects of drugs of abuse on neuropsychological performance? *Neuroscience and Biobehavioral Reviews*, *35*(3), 377–406. https://doi.org/10.1016/j.neubiorev.2010.04.008

Few, L. R., Grant, J. D., Trull, T. J., Statham, D. J., Martin, N. G., Lynskey, M. T., & Agrawal, A. (2014). Genetic variation in personality traits explains genetic overlap between borderline personality features and substance use disorders. *Addiction*, *109*(12), 2118–2127. https://doi.org/10.1111/add.12690

Garcia-Villamisar, D., Dattilo, J., & Garcia-Martinez, M. (2017). Executive functioning in people with personality disorders. *Current Opinion in Psychiatry*, *30*(1), 36–44. https://doi.org/10.1097/YCO.0000000000000299

Gillespie, N. A., Aggen, S. H., Neale, M. C., Knudsen, G. P., Krueger, R. F., South, S. C., Czajkowski, N., Nesvåg, R., Ystrom, E., Kendler, K. S., & Reichborn-Kjennerud, T. (2018). Associations between personality disorders and cannabis use and cannabis use disorder: A population-based twin study. *Addiction*, *113*(8), 1488–1498. https://doi.org/10.1111/add.14209

Goldstein, R. Z., & Volkow, N. D. (2011). Dysfunction of the prefrontal cortex in addiction: Neuroimaging findings and clinical implications. *Nature Reviews Neuroscience*, *12*(11), 652–669. https://doi.org/10.1038/nrn3119

Grant, B. F., Saha, T. D., Ruan, W. J., Goldstein, R. B., Chou, S. P., Jung, J., Zhang, H., Smith, S. M., Pickering, R. P., Huang, B., & Hasin, D. S. (2016). Epidemiology of DSM-5 drug use disorder: Results from the National Epidemiologic Survey on Alcohol and Related Conditions-III. *JAMA Psychiatry*, *73*(1), 39–47. https://doi.org/10.1001/jamapsychiatry.2015.2132

Holmes, E. A., Craske, M. G., & Graybiel, A. M. (2014). Psychological treatments: A call for mental-health science. *Nature News*, *511*(7509), 287–289. https://doi.org/10.1038/511287a

Kienast, T., Stoffers, J., Bermpohl, F., & Lieb, K. (2014). Borderline personality disorder and comorbid addiction: Epidemiology and treatment. *Deutsches Arzteblatt International*, *111*(16), 280–286. https://doi.org/10.3238/arztebl.2014.0280

Klein, M. (2020). Relapse into opiate and crack cocaine misuse: A scoping review. *Addiction Research & Theory*. Advance online publication. https://doi.org/10.1080/16066359.2020.1724972

Kotov, R., Gamez, W., Schmidt, F., & Watson, D. (2010). Linking "big" personality traits to anxiety, depressive, and substance use disorders: A meta-analysis. *Psychological Bulletin*, *136*(5), 768–821. https://doi.org/10.1037/a0020327

Kotov, R., Krueger, R. F., Watson, D., Achenbach, T. M., Althoff, R. R., Bagby, R. M., Brown, T. A., Carpenter, W. T., Caspi, A., Clark, L. A., Eaton, N. R., Forbes, M. K., Forbush, K. T., Goldberg, D., Hasin, D., Hyman, S. E., Ivanova, M. Y., Lynam, D. R., Markon, K., … Zimmerman, M. (2017). The Hierarchical Taxonomy of Psychopathology (HiTOP): A dimensional alternative to traditional nosologies. *Journal of Abnormal Psychology*, *126*(4), 454–477. https://doi.org/10.1037/abn0000258

Krueger, R. F., Derringer, J., Markon, K. E., Watson, D., & Skodol, A. E. (2012). Initial construction of a maladaptive personality trait model and inventory for DSM-5. *Psychological Medicine*, *42*(9), 1879–1890. https://doi.org/10.1017/S0033291711002674

Krueger, R. F., & Markon, K. E. (2014). The role of the DSM-5 personality trait model in moving toward a quantitative and empirically based approach to classifying personality and psychopathology. *Annual Review of Clinical Psychology*, *10*, 477–501. https://doi.org/10.1146/annurev-clinpsy-032813-153732

Langås, A.-M., Malt, U. F., & Opjordsmoen, S. (2011). Comorbid mental disorders in substance users from a single catchment area – a clinical study. *BMC Psychiatry*, *11*(1), 25. https://doi.org/10.1186/1471-244X-11-25

Lawrence, K. A., Allen, J. S., & Chanen, A. M. (2010). Impulsivity in borderline personality disorder: Reward-

based decision-making and its relationship to emotional distress. *Journal of Personality Disorders*, *24*(6), 785–799. https://doi.org/10.1521/pedi.2010.24.6.785

LeGris, J., Links, P. S., van Reekum, R., Tannock, R., & Toplak, M. (2012). Executive function and suicidal risk in women with borderline personality disorder. *Psychiatry Research*, *196*(1), 101–108. https://doi.org/10.1016/j.psychres.2011.10.008

Lev-Ran, S., Segev, A., Braw, Y., & Levkovitz, Y. (2012). Neurocognitive functions of heavy cannabis using schizophrenia patients. *European Psychiatry*, *27*(5), 365–368. https://doi.org/10.1016/j.eurpsy.2011.04.010

Long, E. C., Aggen, S. H., Neale, M. C., Knudsen, G. P., Krueger, R. F., South, S. C., Czajkowski, N., Nesvåg, R., Ystrom, E., Torvik, F. A., Kendler, K. S., Gillespie, N. A., & Reichborn-Kjennerud, T. (2017). The association between personality disorders with alcohol use and misuse: A population-based twin study. *Drug and Alcohol Dependence*, *174*, 171–180. https://doi.org/10.1016/j.drugalcdep.2017.01.022

Lozano, Ó. M., Rojas, A. J., & Fernández Calderón, F. (2017). Psychiatric comorbidity and severity of dependence on substance users: How it impacts on their health-related quality of life? *Journal of Mental Health*, *26*(2), 119–126. https://doi.org/10.1080/09638237.2016.1177771

Ma, G., Fan, H., Shen, C., & Wang, W. (2016). Genetic and neuroimaging features of personality disorders: State of the art. *Neuroscience Bulletin*, *32*(3), 286–306. https://doi.org/10.1007/s12264-016-0027-8

Malloy, P., Noel, N., Longabaugh, R., & Beattie, M. (1990). Determinants of neuropsychological impairment in antisocial substance abusers. *Addictive Behaviors*, *15*(5), 431–438. https://doi.org/10.1016/0306-4603(90)90029-W

Malloy, P., Noel, N., Rogers, S., Longabaugh, R., & Beattie, M. (1989). Risk factors for neuropsychological impairment in alcoholics: Antisocial personality, age, years of drinking and gender. *Journal of Studies on Alcohol*, *50*(5), 422–426. https://doi.org/10.15288/jsa.1989.50.422

Maraz, A., Andó, B., Rigó, P., Harmatta, J., Takách, G., Zalka, Z., Boncz, I., Lackó, Z., Urbán, R., van den Brink, W., & Demetrovics, Z. (2016). The two-faceted nature of impulsivity in patients with borderline personality disorder and substance use disorder. *Drug and Alcohol Dependence*, *163*(1), 48–54. https://doi.org/10.1016/j.drugalcdep.2016.03.015

Massey, S. H., Newmark, R. L., & Wakschlag, L. S. (2018). Explicating the role of empathic processes in substance use disorders: A conceptual framework and research agenda. *Drug and Alcohol Review*, *37*(3), 316–332. https://doi.org/10.1111/dar.12548

Mcclure, G., Hawes, D. J., & Dadds, M. R. (2016). Borderline personality disorder and neuropsychological measures of executive function: A systematic review. *Personality and Mental Health*, *10*(1), 43–57. https://doi.org/10.1002/pmh.1320

Mellentin, A. I., Skøt, L., Teasdale, T. W., & Habekost, T. (2013). Conscious knowledge influences decision-making differently in substance abusers with and without comorbid antisocial personality disorder. *Scandinavian Journal of Psychology*, *54*(4), 292–299. https://doi.org/10.1111/sjop.12054

Moeller, G. F., Dougherty, D. M., Barratt, E. S., Oderinde, V., Mathias, C. W., Andrew Harper, R., & Swann, A. C. (2002). Increased impulsivity in cocaine dependent subjects independent of antisocial personality disorder and aggression. *Drug and Alcohol Dependence*, *68*(1), 105–111. https://doi.org/10.1016/S0376-8716(02)00106-0

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & Group, P, PRISMA Group (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLOS Medicine*, *6*(7), e1000097. https://doi.org/10.1371/journal.pmed.1000097

Moody, L., Franck, C., & Bickel, W. K. (2016). Comorbid depression, antisocial personality, and substance dependence: Relationship with delay discounting. *Drug and Alcohol Dependence*, *160*, 190–196. https://doi.org/10.1016/j.drugalcdep.2016.01.009.

Newton-Howes, G., & Foulds, J. (2018). Personality disorder and alcohol use disorder: An overview. *Psychopathology*, *51*(2), 130–136. https://doi.org/10.1159/000486602

Newton-Howes, G., & Gordon, S. (2017). The recovery paradigm and distress conceptualized as personality disorder: Lack of evidence does not equate to a lack of importance. *Personal Mental Health*, *11*(1), 33–36. https://doi.org/10.1002/pmh.1364

Ogilvie, J. M., Stewart, A. L., Chan, R. C., & Shum, D. H. (2011). Neuropsychological measures of executive function and antisocial behavior: A meta-analysis. *Criminology*, *49*(4), 1063–1107. https://doi.org/10.1111/j.1745-9125.2011.00252.x

Panenka, W. J., Procyshyn, R. M., Lecomte, T., MacEwan, G. W., Flynn, S. W., Honer, W. G., & Barr, A. M. (2013). Methamphetamine use: A comprehensive review of molecular, preclinical and clinical findings. *Drug and Alcohol Dependence*, *129*(3), 167–179. https://doi.org/10.1016/j.drugalcdep.2012.11.016

Paret, C., Jennen-Steinmetz, C., & Schmahl, C. (2017). Disadvantageous decision-making in borderline personality disorder: Partial support from a meta-analytic review. *Neuroscience and Biobehavioral Reviews*, *72*, 301–309. https://doi.org/10.1016/j.neubiorev.2016.11.019

Pye, V., Taylor, N., Clay-Williams, R., & Braithwaite, J. (2016). When is enough, enough? Understanding and solving your sample size problems in health services research. *BMC Research Notes*, *9*(1), 90. https://doi.org/10.1186/s13104-016-1893-x

Rosenthal, R. N., Nunes, E. V., & Le Fauve, C. E. (2012). Implications of epidemiological data for identifying persons with substance use and other mental disorders. *American Journal on Addictions*, *21*(2), 97–103. https://doi.org/10.1111/j.1521-0391.2011.00198.x

Rubio, G., Jiménez, M., Rodríguez-Jiménez, R., Martínez, I., Iribarren, M. M., Jiménez , -Arriero, M. A., Ponce, G., & Avila, C. (2007). Varieties of impulsivity in males with alcohol dependence: The role of Cluster-B personality disorder. *Alcoholism, Clinical and Experimental Research*, *31*(11), 1826–1832. https://doi.org/10.1111/j.1530-0277.2007.00506.x

Samuel, D. B., & Widiger, T. A. (2008). A meta-analytic review of the relationships between the five-factor model and DSM-IV-TR personality disorders: A facet level analysis. *Clinical Psychology Review*, *28*(8), 1326–1342. https://doi.org/10.1016/j.cpr.2008.07.002

Sargeant, M. N., Bornovalova, M. A., Trotman, A. J.-M., Fishman, S., & Lejuez, C. W. (2012). Facets of impulsivity in the relationship between antisocial personality and abstinence. *Addictive Behaviors*, *37*(3), 293–298. https://doi.org/10.1016/j.addbeh.2011.11.012

Saulsman, L. M., & Page, A. C. (2004). The five-factor model and personality disorder empirical literature: A meta-analytic review. *Clinical Psychology Review*, *23*(8), 1055–1085. https://doi.org/10.1016/j.cpr.2002.09.001

Shoptaw, S. (2014). Commentary on Gowin et al. (2014): Brain is behavior-methamphetamine dependence and recovery. *Addiction*, *109*(2), 248–249. https://doi.org/10.1111/add.12442

Skodol, A. E., Clark, L. A., Bender, D. S., Krueger, R. F., Morey, L. C., Verheul, R., Alarcon, R. D., Bell, C. C., Siever, L. J., & Oldham, J. M. (2011). Proposed changes in personality and personality disorder assessment and diagnosis for DSM-5 Part I: Description and rationale. *Personality Disorders*, *2*(1), 4–22. https://doi.org/10.1037/a0021891

Spronk, D. B., van Wel, J. H., Ramaekers, J. G., & Verkes, R. J. (2013). Characterizing the cognitive effects of cocaine: A comprehensive review. *Neuroscience and Biobehavioral Reviews*, *37*(8), 1838–1859. https://doi.org/10.1016/j.neubiorev.2013.07.003

Stavro, K., Pelletier, J., & Potvin, S. (2013). Widespread and sustained cognitive deficits in alcoholism: A meta-analysis. *Addiction Biology*, *18*(2), 203–213. https://doi.org/10.1111/j.1369-1600.2011.00418.x

Stevens, L., Verdejo-García, A., Goudriaan, A. E., Roeyers, H., Dom, G., & Vanderplasschen, W. (2014). Impulsivity as a vulnerability factor for poor addiction treatment outcomes: A review of neurocognitive findings among individuals with substance use disorders. *Journal of Substance Abuse Treatment*, *47*(1), 58–72. https://doi.org/10.1016/j.jsat.2014.01.008

Thompson, R. G., Jr., Eaton, N. R., Hu, M.-C., & Hasin, D. S. (2017). Borderline personality disorder and regularly drinking alcohol before sex. *Drug and Alcohol Review*, *36*(4), 540–545. https://doi.org/10.1111/dar.12476

Thornton, L. K., Baker, A. L., Lewin, T. J., Kay-Lambkin, F. J., Kavanagh, D., Richmond, R., Kelly, B., & Johnson, M. P. (2012). Reasons for substance use among people with mental disorders. *Addictive Behaviors*, *37*(4), 427–434. https://doi.org/10.1016/j.addbeh.2011.11.039

Trull, T. J., Freeman, L. K., Vebares, T. J., Choate, A. M., Helle, A. C., & Wycoff, A. M. (2018). Borderline personality disorder and substance use disorders: An updated review. *Borderline Personality Disorder and Emotion Dysregulation*, *5*(1), 15. https://doi.org/10.1186/s40479-018-0093-9

Trull, T. J., Jahng, S., Tomko, R. L., Wood, P. K., & Sher, K. J. (2010). Revised NESARC personality disorder diagnoses: Gender, prevalence, and comorbidity with substance dependence disorders. *Journal of Personality Disorders*, *24*(4), 412–426. https://doi.org/10.1521/pedi.2010.24.4.412

Tull, M. T., Gratz, K. L., & Weiss, N. H. (2011). Exploring associations between borderline personality disorder, crack/cocaine dependence, gender, and risky sexual behavior among substance-dependent inpatients. *Personality Disorders*, *2*(3), 209–219. https://doi.org/10.1037/a0021878

Verdejo-Garcia, A., Verdejo-Román, J., Albein-Urios, N., Martínez-González, J. M., & Soriano-Mas, C. (2017). Brain substrates of social decision-making in dual diagnosis: Cocaine dependence and personality disorders. *Addiction Biology*, *22*(2), 457–467. https://doi.org/10.1111/adb.12318

Vergés, A., Jackson, K. M., Bucholz, K. K., Trull, T. J., Lane, S. P., & Sher, K. J. (2014). Personality disorders and the persistence of substance use disorders: A reanalysis of published NESARC findings. *Journal of Abnormal Psychology*, *123*(4), 809–820. https://doi.org/10.1037/abn0000011

Widiger, T. A., & Samuel, D. B. (2005). Diagnostic categories or dimensions? A question for the diagnostic and statistical manual of mental disorders. *Journal of Abnormal Psychology*, *114*(4), 494–504. https://doi.org/10.1037/0021-843X.114.4.494

Winsper, C., Lereya, S. T., Marwaha, S., Thompson, A., Eyden, J., & Singh, S. P. (2016). The aetiological and psychopathological validity of borderline personality disorder in youth: A systematic review and meta-analysis. *Clinical Psychology Review*, *44*, 13–24. https://doi.org/10.1016/j.cpr.2015.12.001

Yücel, M., & Lubman, D. I. (2007). Neurocognitive and neuroimaging evidence of behavioural dysregulation in human drug addiction: Implications for diagnosis, treatment and prevention. *Drug and Alcohol Review*, *26*(1), 33–39. https://doi.org/10.1080/09595230601036978