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Neuropsychological performance, impulsivity, ADHD symptoms, and novelty seeking in compulsive buying disorder

Donald Wayne Black[a,*], **Martha Shaw**[a], **Brett McCormick**[a], **John David Bayless**[b], and **Jeff Allen**[a]

[a]Department of Psychiatry, University of Iowa Roy J. and Lucille A. Carver College of Medicine, Iowa City, IA 52242, USA

[b]Division of Neuropsychology, Department of Psychiatry, University of Iowa Roy J. and Lucille A. Carver College of Medicine, Iowa City, IA 52242, USA

Abstract

We examined the neuropsychological performance of people with compulsive buying disorder (CBD) and control subjects, along with trait impulsivity, symptoms of attention deficit hyperactivity disorder (ADHD), and selected personality characteristics. Subjects received a comprehensive neuropsychological test battery, depression and ADHD symptom assessment, the Barratt Impulsiveness Scale, and a version of the Temperament and Character Inventory. Persons with CBD (n=26) and controls (n=32) were comparable in terms of age, sex, and years of education. Subjects with CBD had a mean age of 36.3 years (S.D.=15.7) and an age at onset of 19.7 years (S.D.=7.0). Compulsive buyers had more lifetime mood, anxiety, and impulse control disorders. People with Compulsive buying performed significantly better on the Wechsler Abbreviated Scale of Intelligence Picture Completion task, a test of visual perception; otherwise, there were no consistent differences in neuropsychological measures. They also had elevated levels of self-reported depression, ADHD symptoms, trait impulsivity, and novelty seeking. In conclusion, compulsive buyers have greater lifetime psychiatric comorbidity than controls, and higher levels of self-rated depression, ADHD symptoms, trait impulsivity, and novelty seeking. The present study does not support the notion that there is a pattern of neuropsychological deficits associated with CBD.

Keywords

Compulsive buying disorder; Impulsivity; ADHD symptoms; Novelty seeking; Neuropsychology; Decision-making; Executive function

1. Introduction

Compulsive buying disorder (CBD) is characterized by excessive or poorly controlled preoccupations, urges, or behaviors regarding shopping and spending that lead to subjective distress or impaired quality of life (Black, 2007, 2010). The disorder has an estimated rate of nearly 6% in the adult United States population (Koran et al., 2006). CBD is associated with co-occurring mood, anxiety, substance use, and other impulse control disorders (Black et al., 1998; Mller et al., 2009, 2010a). While most epidemiological and clinical research suggests

*Correspondence address: 2-126b MEB/Psychiatry Research, University of Iowa Carver College of Medicine, Iowa City, IA 52245, USA. Tel.: +1 319 353 4431. donald-black@uiowa.edu (D.W. Black).

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the disorder has a female preponderance (Black, 2010), the survey reported by Koran et al. (2006) found nearly equal rates in men and women. The disorder is not included in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV; American Psychiatric Association, 2000), and there are presently no plans to include it in DSM-5 (www.dsm5.org).

The appropriate classification of CBD has been debated, but some consider it a behavioral addiction similar in many respects to classic alcohol and drug dependencies (Hollander and Allen, 2006). The concept of behavioral addiction includes disorders that the National Institute on Drug Abuse (NIDA) considers relatively pure models of addiction because the presence of an exogenous substance does not contaminate their processes (Holden, 2001). In addition to CBD, potential behavioral addictions include pathological gambling (PG), kleptomania, compulsive sexual behavior, and Internet addiction (Black et al., 2012). These disorders share common core clinical features such as the performance of repetitive behaviors despite negative consequences, diminished control over their urges, craving prior to engaging in the behavior, and experiencing a pleasurable response while engaged in the behavior (Grant et al., 2006). Other potential categorizations have been proposed for these disorders. Hollander (1993a, 1993b) and others (Koran, 1999) have long promoted the concept of an obsessive–compulsive spectrum, but evidence is limited (Dell'Osso et al., 2006; Tavares and Gentil, 2007). Others have suggested that behavioral addictions are related to bipolar disorder (Di Nicola et al., 2010a, 2010b).

Converging evidence from the fields of genetics, neuropharmacology, and brain imaging suggests that CBD is a neuropsychiatric syndrome (Black, 2007, 2010; Raab et al., 2010). The disorder appears familial and has a genetic relationship with mood and substance use disorders (McElroy et al., 1994; Black et al., 1998). Some investigators believe that disturbed neuro-transmission may underlie CBD. This belief has prompted the use of selective serotonin reuptake inhibitors to treat the disorder (Black et al., 2000; Ninan et al., 2000; Koran et al., 2003, 2007), though results have been mixed. Dopamine has been conjectured to play a role in CBD because it is widely believed to mediate reward dependent behaviors (Holden, 2001). The role of dopamine is further suggested by reports that anti-parkinsonian medications that modulate dopamine neurotransmission induce compulsive behaviors including uncontrolled shopping (Lader, 2008). Case reports suggest that naltrexone may help in treating CBD, leading to speculation about the role of opiate receptors in CBD, but naltrexone also affects dopamine neurotransmission (Kim, 1998; Grant, 2003). Finally, a recent functional magnetic resonance imaging study of 23 women with CBD found increased activation of the nucleus accumbens – the brain's putative pleasure center – compared to normal shoppers when subjects were shown products they could buy (Raab et al., 2010). These findings are in agreement with the work of Knutson et al. (2007) who studied purchasing decisions (though not in people with CBD), and of studies of persons with PG or drug addiction whereby images of appropriate stimuli activate the nucleus accumbens (Berridge, 2003; Reuter et al., 2005).

Neuropsychological studies could contribute to a better understanding of the neurobiology of CBD. Research investigations with pathological gamblers have suggested the executive function deficits may be associated with disturbances in fronto-temporal circuitry thereby contributing to impaired decision-making (Goudriaan et al., 2004; Forbush et al., 2008; Marraziti et al., 2008). Because both disorders are considered behavioral addictions, it is not unreasonable to propose that people with CBD might have similar neurop-sychological profiles to those with PG. Bechara (2003) has described patients with executive function deficits as having a "myopia of the future" because of their failure to consider future consequences. This is an apt description of many people with CBD.

Knowledge of selected personality traits may also help clinicians better understand and manage CBD. There is a growing appreciation that, like PG, CBD is associated with trait impulsivity, despite the fact there have been few formal investigations. Lejoyeux et al. (1997) reported that a group of 38 depressed inpatients with CBD had elevated trait impulsivity on all three subscales of the Barratt Impulsiveness Scale (Barratt, 1959). DeSarbo and Edwards (1996) used the NEO Personality Inventory (NEOPI; Costa and McCrae, 1985) in a group of 104 self-identified persons with CBD and found high levels of impulsiveness. Mller et al. (2010b) recently used the NEOPI to assess personality in a group of 68 compulsive buyers. Cluster analysis yielded two clusters, one of which was associated with greater CBD severity, higher trait impulsivity, more comorbid psychiatric disorders, and lower rates of remission.

We have become increasingly interested in assessing childhood and adult symptoms of attention deficit hyperactivity disorder (ADHD) in pathological gamblers, symptoms that research shows are relatively common in these individuals (Black et al., in press). Interestingly, we have found not only high levels of ADHD symptoms in people with PG, but that these levels fall with treatment of the disordered gambling (Black et al., 2007a, 2007b, 2008). This could suggest that ADHD symptoms help mediate disordered gambling or, possibly, they are behavioral markers of the disorder. The same could be true for CBD. None of the published CBD comorbidity studies (Christenson et al., 1994; Schlosser et al., 2004; Black et al., 1998; Mller et al., 2010a) have reported on the prevalence of ADHD symptoms. This may have more to do with the lack of assessment rather than the lack of an association, because the instruments used in these studies have not assessed ADHD.

The purpose of this pilot study was to gain a better understanding of the neuropsychological performance of persons with CBD. Because CBD and PG appear to intertwine (de Zwaan, 2010), we thought it worthwhile to also assess trait impulsivity, ADHD symptoms, and selected personality characteristics. Based on our experience, and drawing from the literature on PG, we expected people with CBD to perform more poorly on neuropsychological tests, including indices of executive function (e.g., cognitive flexibility, decision-making) than controls, but that general cognition and memory would not differ between the groups. We further hypothesized that persons with CBD would have higher levels of trait impulsivity and ADHD symptoms, and that those who were highly impulsive would perform more poorly on tests of executive function and comprise a subset. Developing a better understanding of the interrelation of neuropsychological performance, trait impulsivity, and ADHD symptoms in persons with CBD has the potential to foster new treatment approaches and preventive strategies.

2. Methods

2.1. Subjects and study design

Men and women ≥18 years who met the criteria of McElroy et al. (1994) for CBD were recruited through newspaper advertisements and word-of-mouth. Subjects had to score ≥2 standard deviations below the mean on the Compulsive Buying Scale (CBS), shown to differentiate compulsive from non-compulsive buyers (Faber and O'Guinn, 1992). They also had to have CBD for ≥1 year. Control subjects were recruited in the course of another study through advertisements (Black et al., in press). Controls could not have PG or CBD; the presence of PG and CBD was assessed using the Minnesota Impulsive Disorders Interview (MIDI) (Christenson et al., 1994; Grant et al., 2005). Exclusions for people with CBD or controls included having: a current or past diagnosis of schizophrenia, bipolar disorder, schizoaffective disorder, or a primary neurological disorder (e.g., Parkinson's disease); major depression within the last 3 months; a substance use disorder in the past 3 months (except tobacco dependence); evidence of cognitive impairment (i.e., had a Mini Mental

State Score <23; Folstein et al., 1975); or a history of head injury with loss of consciousness lasting >10 min. Subjects gave written, informed consent according to procedures approved by the University of Iowa Institutional Review Board. All received compensation ($25).

2.2. Assessments

The neuropsychological test battery consisted of the following: the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) to assess intellectual functioning; the Wide Range Achievement Test-3 Reading Scale to assess reading skills (WRAT; Wilkinson, 1993); the Stroop Color Word Test (Stroop, 1992) and Letter–Number Sequencing subtest from the Wechsler Adult Intelligence Scale (WAIS-III; Wechsler, 1997) to assess sustained and selective attention, cognitive inhibition, and working memory; Trails A and B (Reitan, 1992) to assess motor planning and cognitive shifting; the Wisconsin Card Sorting Test-64 (WCST-64; Berg, 1948) to assess executive function, including the ability to form, test, and alter problem solving strategies in response to external feedback; the Iowa Gambling Task (IGT; Bechara et al., 1997) to measure decision-making capacity under differing risk conditions; the WAIS-III Picture Completion subtest to measure ability to perceive visual details quickly; the Controlled Word Association Test (COWAT; Benton, 1969) and the Boston Diagnostic Aphasia Examination (BDAE) Animal Naming Test (Goodglass and Kaplan, 1983) to assess verbal fluency; the Hopkins Verbal Learning Test-Revised (HVLT-R; Brandt and Benedict, 2004) to assess verbal learning and memory; and the Brief Visuospatial Memory Test-Revised (BVMT-R; Benedict, 1997) to assess visual learning and memory.

Rater-administered psychiatric instruments included: the Mini International Neuropsychiatric Interview-Plus (MINI; Sheehan et al., 1998) to assess DSM-IV disorders; the Minnesota Impulsive Disorders Interview (MIDI; Christenson et al., 1994; Grant et al., 2005) to assess the presence of impulse control disorders; and the Yale-Brown Obsessive–Compulsive Scale-Shopping Version (YBOCS-SV; Monahan et al., 1996) to assess CBD severity. Self-report instruments were administered including the Beck Depression Inventory (BDI; Beck, 1978) to assess symptoms of depression; the Barratt Impulsiveness Scale (BIS; Barratt, 1959, 1983) to assess severity of motor, cognitive, and non-planning impulsiveness; the ADHD Rating Scale (DuPaul, 1991) to evaluate the presence and severity of symptoms of ADHD; and a version of the Temperament and Character Inventory (TCI; Cloninger et al., 1993, 1994) to assess novelty seeking, harm avoidance, and reward dependence. In addition, we collected relevant social and demographic data.

3. Data analysis

χ^2 tests (or Fisher's exact tests) and t-tests were used to compare demographic and clinical characteristics of the groups. ANOVA was used to compare neuropsychological characteristics of the two groups (SAS Institute Inc., 2004). The neuropsychological variables compared included measures of memory (HVLT total recall and delayed recall, BVMT total recall and delayed recall), executive functioning (WCST total errors, perseverative responses, non-perseverative errors, perseverative errors, learning to learn, and categories completed; Trails B, COWAT, Stroop interference, and IGT net total), and attention (Stroop color naming, word reading, and Trails A). Other measures included the BDAE Animal Naming Total, WAIS Letter Number Sequencing and Picture Completion, and the Wide Range Achievement Test (WRAT).

ANOVA was also used to test for group differences in personality characteristics measured by the BIS total score, three BIS subscales (Attentional, Motor, and Non-planning), and the three scales of the TCI (novelty seeking, harm avoidance, and reward dependence). CBD

subjects and controls were also compared on ADHD symptom clusters (Hyperactivity, Impulsivity, and Inattentiveness), as well as individual items of the ADHD Rating Scale.

For the BIS, the threshold of ≥72 has been suggested to define "high impulsivity" (Stanford et al., 2009), whereas a score of >8 has been suggested to define "high ADHD symptoms" with the ADHD Rating Scale (Braaten and Rosen, 1997). For people with CBD, the neuropsychological variables were compared for those with high levels of impulsivity and those without. Similarly, the neuropsychological variables were compared for those with high levels of ADHD symptoms and those without.

4. Results

4.1. Baseline comparison

Twenty-eight persons with CBD were recruited and screened. Two were later dropped from the analysis for not meeting study criteria (one due to a bipolar disorder, the other due to a history of head injury and loss of consciousness). Controls were collected in the course of another study. From a pool of 65 subjects, 32 were selected to approximately match the age, sex, and educational profile of the group with CBD. The final sample consisted of 26 subjects with CBD and 32 controls.

The groups were comparable for age, gender, race, and years of education (Table 1). Most of the individuals with CBD were female (88%) and Caucasian (85%); they had a mean age of 36.3 years (S.D.=15.7). Mean age at onset of CBD was 19.7 years (S.D.=7.0). The mean YBOCS-SV score of 20.2 (S.D.=5.2) suggested moderate severity. Controls had slightly higher full-scale IQs (M=112.0, S.D.=12.0) than subjects with CBD (M=107.7, S.D.=12.1), although the difference was not significant (p=0.182). Individuals with CBD were more likely to have high levels of trait impulsivity (46% vs. 16%; χ^2=6.1, p=0.01); they also had significantly higher dimensional levels of depression and ADHD symptoms than controls. They were significantly more likely than controls to have co-occurring lifetime psychiatric disorders, including mood, anxiety, and impulse control disorders, but not substance use disorders, somatoform disorders, antisocial personality disorder, or ADHD.

4.2. Comparison of groups on neuropsychological measures, the BIS, and Cloninger's traits

People with CBD performed similarly to controls on neuropsychological measures (Table 2). CBD subjects scored significantly higher on the Picture Completion task of the WASI (d=0.68, p=0.009), but no other significant differences were found. Group differences of 0.30 standard deviations and larger, while not statistically significant at p=0.05, favored the Control group on Trails B, COWAT, Stroop Color Naming, and IGT scores. Non-significant group differences that favored the CBD group with d>0.30 included HVLT total recall, BVMT total recall, and BVMT delayed recall scores.

People with CBD exhibited greater novelty seeking (d=0.75, p=0.004), but differences in harm avoidance and reward dependence were not significant (Table 3). They also exhibited greater trait impulsivity (d=0.85, p=0.001). Interestingly, the largest difference existed for the BIS Motor subscale (d=1.14). Moderate differences were observed for the BIS Attentional (d=0.53, p=0.044) and Non-planning (d=0.52, p=0.049) subscales.

4.3. Correlational analyses

BIS total score and ADHD Rating Scales scores were highly correlated (r=0.64, p<0.001 overall; r=0.53, p=0.006 among subjects with CBD). Combining data from both groups, each BIS subscale was correlated with ADHD rating scales (r=0.46, 0.54, and 0.46 for BIS

Motor, Non-planning, and Attentional, respectively, each $p<0.001$). Among subjects with CBD, BIS Motor ($r=0.38$, $p=0.053$), Non-planning ($r=0.40$, $p=0.045$) and Attentional ($r=0.61$, $p<0.001$) were all correlated with ADHD symptoms. Among CBD subjects, CBS scores were significantly correlated with BIS Motor ($r=-0.57$, $p=0.002$); correlations with Non-planning ($r=-0.28$) and Attentional ($r=-0.31$) were in the expected direction, but not significant. CBS scores were significantly correlated with BIS total score ($r=-0.44$, $p=0.024$) and ADHD symptoms ($r=-0.40$, $p=0.045$). The correlation with level of depression (BDI) was not significant ($r=-0.23$, $p=0.267$).

4.4. ADHD rating scale analyses

We explored the three symptom clusters and items for the ADHD Rating Scale (Table 4). This comparison revealed that CBD subjects had more ADHD symptoms, but that the group differences varied across symptom clusters and items. The most pronounced difference was for the Inattentiveness symptom cluster ($d=0.52$, $p=0.047$), particularly the individual items: “Fidgety” ($d=0.61$), “Difficulty waiting turn” ($d=0.71$), and “Loses things” ($d=0.53$).

Among CBD subjects, novelty seeking was correlated with BIS impulsivity ($r=0.45$, $p=0.021$) and the ADHD Rating Scale score ($r=0.44$, $p=0.025$ for ADHD total score; $r=0.40$, $p=0.044$ for ADHD hyperactivity subscale; $r=0.44$, $p=0.025$ for ADHD impulsivity subscale; and $r=0.37$, $p=0.065$ for ADHD inattentive subscale).

4.5. Subjects with CBD with high impulsivity or ADHD symptoms compared to others

Comparisons of neuropsychological variables between CBD subjects with high impulsivity and those without revealed few significant differences (data not shown). Of the 21 neuropsycho-logical variables tested, only one (Trails B) showed a significant difference for highly impulsive people with CBD, with the highly impulsive group performing worse. Comparisons between those with CBD with high ADHD and those without revealed no significant differences (data not shown).

5. Discussion

People with CBD in this pilot study were similar demographically and clinically to those described by other investigators, and their disorder was of moderate severity (Christenson et al., 1994; McElroy et al., 1994; Ninan et al., 2000; Miltenberger et al., 2003; Koran et al., 2003, 2007). In short, CBD was primarily a disorder of middle-aged women who had struggled with the condition for nearly 17 years. We were able to confirm some, but not all of our hypotheses. First, we found no consistent differences in neurop-sychological test performance between those with CBD and controls, including executive function. Interestingly, compulsive buyers performed significantly better on the WASI Picture Completion task, which is a test of visual perception, a finding that may reflect their intense interest in consumer goods. While controls had higher full scale IQs, this difference was not statistically significant. Second, we found that those with CBD had significantly higher levels of trait impulsivity and ADHD symptoms than controls, findings that were not surprising. In terms of selected personality characteristics described by Cloninger et al. (1993, 1994), we found high levels of novelty seeking, but not risk aversion or reward dependence. Lastly, we failed to confirm our hypothesis that high levels of trait impulsivity or ADHD symptoms would identify a subset of persons with CBD based on neuropsychological performance.

Our work is consistent with the work of Lejoyeux et al. (1997) and DeSarbo and Edwards (1996) in confirming that people with CBD are impulsive. Like Lejoyeux et al., we found elevated scores on all BIS subscales. The BIS is a standard tool for measuring impulsivity, and its three scales reflect major components of impulsivity identified through factor

analysis. Barratt (1983) conceptualized *cognitive impulsiveness* as making quick decisions; *motor impulsiveness* as acting without thinking, and *non-planning impulsiveness* as lacking forethought. This finding comes as no surprise considering the behavior of those with CBD who are often described as spending without adequate reflection, having difficulty delaying their buying urges, and seeking immediate gratification though their spending (Lejoyeux et al., 1997; Miltenberger et al., 2003; Black, 2007).

Trait impulsivity is a leading contributor to individual's loss of control over his or her shopping and spending behavior. We believe this contributes to a phenomenon analogous to that seen in pathological gamblers whereby impulsive gamblers seek out games with rapid, intermittent payout (e.g., slots). With CBD, the person engages in frequent buying of low cost items, rather than less frequent shopping for higher cost items (Christenson et al., 1994; Schlosser et al., 2004). Impulsivity may also contribute to the compulsive buyer's inability to divide his attention among competing stimuli, and causing him to ignore internal cognitions focusing on restraint. This is a pattern described in pathological gamblers (McCown and Chamberlain, 2000). While high scores do not appear to identify a subset with impaired neuropsychological performance, one use of the BIS may be to help identify people with CBD who are more treatment-resistant or are more likely to drop out of treatment (Moeller et al., 2001; Patkar et al., 2004; Black et al., 2009). This information could have implications for treatment programs.

An important finding was that ADHD symptoms are common in those with CBD, even though a lifetime diagnosis of ADHD is not. While their ADHD Rating Scale scores are lower than those reported for people with ADHD (Kuperman et al., 2001; Spencer et al., 1995), they are much higher than scores of controls, and are similar to scores in persons with PG (Black et al., 2007a, 2007b). Further, ADHD symptoms were highly correlated with trait impulsivity. This is not surprising considering that impulsivity is a defining feature of ADHD (American Psychiatric Association, 2000). The inattentiveness cluster was significantly different from controls, specifically the items "fidgety," "difficulty waiting turn," and "loses things." One can imagine the person with CBD who is anxious and fidgety as she waits in line to make a purchase, or cannot find an item of clothing she has misplaced in her crowded closet.

We have also linked CBD to novelty seeking, one of several personality dimensions described by Cloninger et al. (1993, 1994). Their unified biosocial model of personality identifies three heritable personality dimensions each thought to represent an independent behavioral response disposition. Each dimension is hypothesized to be linked with a different neurotransmitter system. In this case, novelty seeking has been linked to low basal dopamine activity, which means that a person would need excitement to raise their low level of arousal, and perhaps for these persons shopping and spending serves that need. To place these findings in perspective, people who score high on *novelty seeking* are described as impulsive, extravagant, and disorderly. This description is consistent with the finding of high levels of both impulsivity and ADHD symptoms. There was no concomitant increase in harm avoidance or reward dependence.

These findings are preliminary and should be interpreted with caution. There are several methodological limitations to acknowledge. First, subjects with CBD and controls were recruited through advertising and word-of-mouth and may not be as representative as if they had been recruited through a random community survey. Additionally, the controls were not specifi-cally matched to the individuals with CBD because they were selected in the course of another study (Black et al., in press). Second, the number of subjects was relatively small which increases the potential for a Type II error (i.e., finding no difference when one is present). For example, comparisons of several tests of executive function favored the

controls (Stroop Color Naming, Trails B, IGT), suggesting that with larger samples we may have found that those with CBD performed significantly worse than controls. Third, testing was not conducted blind to CBD status, and this may have inadvertently affected the results. Fourth, while our sample is likely more representative of the general population of individuals with CBD than treatment-seeking samples, it is possible that a subjects' reason for volunteering for the study may have affected our results. Fifth, CBD subjects had a higher rate of comorbid disorders, and this could have played a role in the study results. Sixth, the version of the ADHD Rating scale used in this study was originally developed for use in children and is based on DSM-III-R criteria (American Psychiatric Association, 1987). While valid in adult populations (Spencer et al., 1995; Kuperman et al., 2001), it has been superseded by a version based on DSM-IV (Murphy and Adler, 2004), the use of which presumably could have led to different results. Finally, we examined three of Cloninger's traits and did not administer the full TCI, so we are unable to comment on the other personality characteristics assessed with this instrument such as self-directedness or cooperativeness.

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Table 1

Demographic and clinical characteristics in persons with CBD and controls.

Variable	CBD (*n* =26)		Control (*n*=32)		*t*	*p*
	Mean	S.D.	Mean	S.D.		
Age (years)	36.3	15.7	39.4	14.8	−0.77	0.445
Age of CBD onset (years)	19.7	7.0				
Education (years)	15.2	2.3	14.8	2.1	0.70	0.485
BDI score	10.8	7.7	6.2	6.8	2.45	0.018
ADHD Rating Scale score	12.7	8.2	8.4	7.1	2.16	0.035
WASI 4 Full IQ	107.7	12.1	112.0	12.0	31.35	0.182
YBOCS-SV score	20.2	5.2				
CBS score	−3.9	1.5				

	n	%	n	%	χ^2	p
Gender						
Female	23	88	27	84		0.720[a]
Male	3	12	5	16		0.113[a]
Race/ethnicity						
Caucasian	22	85	24	75		
African–American	0	0	5	16		
Hispanic	3	12	2	8		
Asian	1	4	0	0		
American Indian	0	0	1	3		
Highly impulsive[b]	12	46	5	16	6.09	0.014
High ADHD symptoms[c]	17	65	11	34	5.52	0.019
Diagnosis (lifetime)						
Mood disorder	16	62	2	6	20.49	<0.001
Anxiety disorder	13	50	3	9	11.85	<0.001
Substance use disorder	6	23	4	13		0.319[a]
Eating disorder	0	0	1	3		1.000[a]
ADHD	1	4	2	6		1.000[a]

	n	%	n	%	χ^2	p
ASPD	0	0	0	0		NA
ICD	18	69	2	6	25.19	<0.001
Somatoform disorder	3	12	1	3		0.316[a]
Any disorder	21	81	17	53	4.85	0.028

ADHD=attention deficit hyperactivity disorder; ASPD=antisocial personality disorder; BIS=Barrett Impulsivity Scale; BDI=Beck Depression Inventory; CBS=Compulsive Buying Scale; WASI=Wechsler Adult Intelligence Scale; YBOCS-SV=Yale-Brown Obsessive Compulsive Scale; ICD=Impulse Control Disorder.

[a]Fisher's Exact Test.

[b]BIS total score ≥72.

[c]ADHD Checklist score >8.

Table 2

Neuropsychological performance in persons with CBD and controls.

Measure	CBD (*n*=26)		Control (*n*=32)		*d*	*F*	d.f.	*p*
	Mean	S.D.	Mean	S.D.				
HVLT-R								
Total recall (Raw)	27.7	3.6	26.6	3.7	0.31	1.3	55	0.254
Delayed recall (Raw)	9.8	2.0	9.6	2.1	0.10	0.1	55	0.710
BVMT-R								
Total recall (Raw)	26.5	6.2	23.9	6.7	0.39	2.2	55	0.147
Delayed recall (Raw)	10.3	1.8	9.7	2.1	0.31	1.3	54	0.251
WRAT (t-score)	53.2	5.6	52.4	4.9	0.16	0.3	54	0.561
WCST								
Total errors (Raw)	12.3	4.5	11.6	4.7	0.15	0.3	53	0.583
Perseverative responses (Raw)	7.3	4.0	6.4	2.7	0.26[a]	0.9	54	0.341
Non-perseverative errors (Raw)	5.6	2.4	5.5	3.4	0.03[a]	0.0	53	0.906
Perseverative errors (Raw)	6.7	3.0	6.3	2.6	0.14[a]	0.3	54	0.601
Categories completed (Raw)	4.1	0.9	4.0	1.1	0.08	0.1	53	0.760
Learning to learn	−1.9	6.0	−1.5	5.2	−0.06	0.0	50	0.826
Trails A (s)	22.5	7.1	20.8	5.5	0.28[a]	1.1	55	0.290
Trails B (s)	71.4	46.3	55.6	27.0	0.42[a]	2.5	54	0.116
BDAE-R animal naming test	21.7	5.2	22.7	5.4	−0.19	0.5	56	0.478
COWAT	40.8	14.0	46.5	10.4	−0.46	3.1	56	0.083
WAIS								
Letter number sequencing	11.5	2.7	11.3	2.6	0.08	0.1	56	0.755
Picture completion	22.4	1.9	20.9	2.2	0.68	7.3	55	0.009
Stroop								
Color Naming	79.2	12.8	84.1	13.1	−0.38	2.1	56	0.152
Word reading	101.7	18.5	106.4	15.9	−0.27	1.1	56	0.304
Interference	47.0	8.8	47.0	7.2	0.00	0.0	55	0.988
IGT net total (Raw)	14.0	24.9	24.0	27.6	−0.38	1.9	50	0.176

COWAT=Controlled Oral Word Association Test; IGT=Iowa Gambling Task; BDAE-R=Boston Diagnositic Aphasia Exam; HVLT-R=Hopkins Verbal Learning Task-Revised; BVMT-R=Brief Visuospatial Memory Test-Revised; WCST=Wisconsin Card Sort Test; WRAT=Wide Range Achievement Test.

[a]Positive difference (*d*) suggests Control group performed better.

Table 3

Selected personality measures in persons with CBD and controls.

Measure	CBD (*n*=26)		Control (*n*=32)		*d*	*F*	d.f.	*p*
	Mean	S.D.	Mean	S.D.				
BIS Total Score	71.5	13.0	61.3	8.9	0.85	12.4	55	0.001
Attentional	18.1	4.2	16.0	3.6	0.53	4.3	56	0.044
Motor	26.9	4.8	21.1	3.6	1.14	27.4	56	<0.001
Non-planning	26.5	6.0	23.7	4.6	0.52	4.1	56	0.049
TCI								
Novelty seeking	58.8	10.3	49.9	11.8	0.75	9.2	56	0.004
Harm avoidance	54.2	12.0	55.1	9.9	−0.09	0.1	56	0.733
Reward dependence	50.9	9.4	51.8	8.9	−0.10	0.1	56	0.713

BIS=Barrett Impulsivness Scale; TCI=Temperament and Character Inventory.

Table 4

Symptom scores on the ADHD Rating Scale[a] in persons with CBD and controls.

Symptom cluster	CBD (*n*=26)		Control (*n*= 32)		*d*	*F*	d.f.	*p*
	Mean	S.D.	Mean	S.D.				
Hyperactivity (overall)	3.1	2.2	2.2	2.3	0.39	2.2	55	0.146
Difficulty remaining seated	0.6	0. 7	0.4	0.6	0.39	2.1	54	0.150
Fidgety	1.3	1.0	0.7	0.8	0.61	5.8	56	0.019
Difficulty working quietly	0.4	0.7	0.3	0.6	0.14	0.3	55	0.613
Talks excessively	0.9	1.1	0.7	−0.8	0.20	0.6	55	0.458
Impulsivity (overall)	2.6	2.0	1.6	1.9	0.49	3.5	56	0.066
Interrupts or intrudes	0.7	0.8	0.6	0.8	0.21	0.7	56	0.424
Blurts out answers	0.5	0.6	0.5	0.7	30.08	0.1	55	0.764
Difficulty waiting turn	0.8	0.7	0.3	0.5	0.71	7.7	54	0.007
Act before thinking	0.2	0.4	0.1	0.3	0.21	0.6	53	0.450
Inattentiveness (overall)	6.7	4.4	4.6	3.8	0.52	4.1	56	0.047
Difficulty sustaining attention	1.0	1.0	0.6	0.8	0.46	3.2	56	0.080
Shifts activities	1.2	1.1	1.1	0.9	0.11	0.2	56	0.691
Difficulty following instructions	0.4	0.6	0.3	0.6	0.09	0.1	52	0.755
Easily distracted	1.5	0.9	1.0	0.9	0.45	3.0	56	0.088
Loses things	1.0	1.0	0.5	0.7	0.53	4.2	56	0.045
Does not listen	1.3	0.8	1.0	0.8	0.45	2.9	56	0.092

ADHD=attention deficit hyperactivity disorder.

[a]ADHD Rating Scale symptom scores range from 0 to 3 (0—not at all, 3—very much).