Published in final edited form as:
J Psychiatr Pract. 2010 November ; 16(6): 405–412. doi:10.1097/01.pra.0000390759.04581.7c.

Investigating the Relationship between Sexual and Chemical Addictions by Comparing Executive Function in Pedophiles, Opiate Addicts and Healthy Controls

Lisa J. Cohen, PhD[1], **Cristina Nesci**[1], **Matthew Steinfeld, M.A.**[2], **Sophia Haeri, M.A.**[2], and **Igor Galynker, M.D., PhD.**[1]

[1]Beth Israel Medical Center/Albert Einstein College of Medicine, NY, NY

[2]The New School, NY, NY

Abstract

Disorders of driven sexual behavior have been conceptualized as sexual addictions. In the following study, we compared 51 subjects with pedophilia, 53 subjects with opiate addiction, and 84 healthy control subjects on neuropsychological tests that tap executive functions. The test battery included the Wisconsin Card Sorting Test (WCST), Stroop Color-Word Test, the Matching Familiar Figures Test (MFFT), Porteus Mazes, Controlled Word Association (COWA), and Trailmaking Test. The groups differed on tests of cognitive flexibility and set switching (WCST), sustained attention (Stroop), and impulsivity (MFFT and Porteus Mazes). There were no differences on verbal fluency (COWA). The subjects with pedophilia differed significantly from those with opiate addiction on several tests, with longer latency to response on MFFT and fewer completed mazes but also fewer errors on Porteus Mazes. Thus, while both subjects with pedophilia and those with opiate addiction show executive dysfunction, the nature of that dysfunction may differ between the two groups; specifically, opiate addicted subjects may be more prone to cognitive impulsivity.

Keywords

sexual addiction; pedophilia; neuropsychology; behavioral addiction; opiate addiction; executive functioning; sexual disorders; neuropsychological testing

Introduction

Pedophilia is one of the few psychiatric disorders characterized by criminal behavior. Unfortunately, pedophilia remains difficult to treat and relapse is a continual problem.[1-3] As such, novel approaches to the conceptualization of pedophilia may open directions for new treatments.

The concept of behavioral addictions has received increasing attention in recent years and inclusion of behavioral addictions into the classification of substance use disorders has been proposed for DSM-5.[4] Likewise disorders of driven sexual behavior have been conceptualized by some as sexual addictions.[5,6] In this context, it is worthwhile to consider whether pedophilia can be fruitfully conceptualized in this way. Because chemical addictions are the best researched form of addictions with the most established treatment

Address for correspondence: Lisa J. Cohen, PhD, Beth Israel Medical Center, 1st Ave. & 16th St., NY, NY 10003, Lcohen@chpnet.org.

paradigm, it is informative to compare a pedophilic sample with a sample of chemically addicted subjects.

In any form of addiction, failure to inhibit pleasurable but destructive urges plays a central role. As behavioral disinhibition has long been linked to dysfunction in frontal lobe related executive functions,[7-9] neuropsychological investigation of executive functions can potentially shed light on the underlying mechanisms of addictive behaviors. In the following study, we compared three groups of subjects (subjects with pedophilia, subjects with opiate addiction, and healthy controls) on a battery of neuropsychological tests that tap executive functions.

In previous studies, both clinical groups have shown lowered executive functions relative to healthy controls.[10-13] although findings are less consistent with pedophilic samples. Nonetheless, to our knowledge, the two groups have never been compared with each other.

Among samples of individuals with pedophilia, there are reports of lowered IQ compared to the general population,[12,14] electroencephalographic (EEG) abnormalities during verbal fluency tasks,[15] generalized neuropsychological impairment on the Wechsler Adult Intelligence Scale-Revised (WAIS-R)[16] and the Halstead-Reitan battery,[12,17] reduced memory function,[14] and abnormal frontal activity on brain imaging studies, [18,19] as well as specific findings of executive dysfunction on neuropsychological tasks.[20,21] On the other hand, our group did not find differences between subjects with pedophilia and healthy controls on a battery of executive function tests.[19]

However, these samples may be confounded by the level of impulsivity and comorbid psychopathology. Pedophilic samples vary widely with regard to comorbid conditions that can render them vulnerable to disinhibition.[22] For example, a study of clerical vs. nonclerical men with pedophilia found significant differences in psychopathic traits.[23] Further, Langevin et al.[12] found that neuropsychological impairment was correlated with violence but not with pedophilia per se. As both of these traits are associated with impulsive aggression,[7,8] it is useful to differentiate cognitive impulsivity from other forms of executive dysfunction.

Research on executive function in opiate addicted samples is quite robust. Opiate addicts have demonstrated impairment on the Gambling Task,[24,25] Porteus Mazes,[11,26] Stroop Color-Word Test,[10,27] tests of verbal fluency,[28] and tests of response inhibition.[29]

Thus there is evidence for executive dysfunction in both putatively addicted groups. However, in our own earlier research, we found pedophilic subjects had lower levels of impulsive personality traits than opiate addicted subjects and were comparable to controls in this regard.[30,31] Thus it is possible that either the level or nature of executive dysfunction may differ between the two groups. Such differences could potentially have implications for therapeutic or preventative interventions.

Methods

Participants

Subjects included 51 male subjects with pedophilia, 53 male and female subjects with opiate addiction in sustained remission, and 84 male and female healthy controls. All subjects were English speaking and between 18 and 65 years of age. Exclusion criteria for all subjects included 1) current or lifetime history of significant Axis I psychiatric disorder other than the index disorder; 2) cognitive impairment sufficient to interfere with completing the study instruments; and 3) inability to give informed consent.

Pedophilic subjects were recruited from an outpatient facility specializing in the treatment of sexual offenders. All pedophilic subjects admitted to committing and were charged for or convicted of a sexual offense against a prepubescent child (age 13 or younger) when the subject was at least 18 years of age, or when he was at least 5 years older than his victim.

Opiate addicts in sustained remission were recruited from the SuCasa methadone to abstinence residential treatment program. All opiate addicted subjects had at least a 2-year history of opiate dependence, were abstinent from illicit substances, and had been detoxified from methadone for at least 6 months. We also administered a urine toxicology test to insure drug abstinence.

Healthy controls were recruited from advertising in New York City community newspapers. Exclusion criteria included 1) meeting DSM-IV criteria for a substance-related disorder within 6 months prior to the study (controls and subjects with pedophilia) and 2) history of pedophilia or of sexual activity as an adult with anyone under the age of 15, or with anyone at least 5 years younger than the subject when the subject was younger than 18 (controls and opiate addicted subjects).

This study analyzed neuropsychological data collected as part of a research program investigating neuropsychiatric characteristics of behavioral and chemical addictions.[10,30]. Because different subjects were recruited for different research studies within the same research program, sample sizes vary across the different neuropsychological tests administered.

Assessments

Neuropsychological tests probed four cognitive function clusters related to executive functions: set switching/cognitive flexibility, sustained attention, impulsivity, and verbal fluency. The testing battery included:

1. **Controlled Oral Word Association (COWA):** A test of verbal fluency.[32] Subjects are given one minute to say as many words as they can that begin with a specified letter. The number of correct responses and errors are recorded.
2. **Matching Familiar Figures Test (MFFT):** A test of visual analysis and impulsivity.[33,34] From among 6 pictures, subjects are asked to identify the one that is identical to the target. Subjects continue selecting pictures until they choose correctly. Average time to first response and the total number of choices were recorded. Two sets of 12 images were used; the first set was labeled MFFT 1 and the second set MFFT 2. MFFT 2 was considered to be more difficult than MFFT 1.
3. **Porteus Mazes:** A test of visual analysis, motor control, and impulsivity.[26] The task consists of a series of increasingly difficult mazes. If a subject makes a mistake, he or she commences a new trial. The number of mazes completed (test age and maximum correct), the total number of errors (deductions), and the number of stylistic errors (qualitative score) are recorded.
4. **Stroop Color-Word Test:** A test of sustained attention and resistance to distraction (for a review, see MacLeod[27]). Subjects are asked to name the printed color of displayed color-words and control stimuli, even when the color of the ink and the color-word are not congruent. Eighty subjects received the 2001 version and 107 subjects received the 1994 version. Since the means and standard deviations from the two versions were comparable (e.g., 92.9 ± 17.8 vs. 93.8 ± 19.4 for Stroop-Word), Stroop data were combined into one data set.

5. **Trailmaking Test:** A test of sustained attention and set switching.[17] In Part A, subjects are asked to connect an array of numbers in order. Part B requires subjects to connect an array of numbers and letters in alternating numerical and alphabetical order (e.g., 1, A, 2, B). The time taken to successfully complete each part is recorded. Both Part A and B measure sequencing and sustained attention; Part B also measures set-switching.

6. **Wisconsin Card Sorting Test (WCST):** A test of category formation and set switching.[35] Subjects are asked to correctly categorize cards based on verbal feedback. Successful completion requires the subject to shift flexibly from one sorting rule to another in response to feedback and to maintain the appropriate set while sorting to a reinforced rule. The 1999 computerized version of the WCST was administered.

Procedure

The study's purpose and procedure were fully explained to all potential participants. Those who expressed interest and met study criteria provided written informed consent prior to entering the study. This study and the consent forms used were approved by the Beth Israel Institutional Review Board. Subjects were then further screened using a modified version of the structured interview for DSM-IV Axis I.[36] Demographic data, history of pedophilic behavior, and history of substance use were collected via measures designed for this study. A trained member of the research staff administered the neuropsychological battery in standard fashion and subjects were reimbursed $15 per hour for their time.

Statistical Analysis

The three groups were compared on demographic variables with univariate analyses of variance (ANOVAs) for continuous variables and χ^2 analyses for categorical variables. In order to control for the potential confounds of demographic differences across groups, a compound score of neuropsychological performance was calculated and then correlated with each demographic variable that differed significantly across groups. The compound neuropsychological score was calculated in two steps. First, 12 variables from the six neuropsychological tests were transformed into 3-level categorical variables (bottom third, middle third, top third) according to the sample distribution. The twelve new categorical variables were then averaged to create the compound neuropsychological score. Any demographic variable that was significantly associated with the compound neuropsychological score was then entered into later analyses as a covariate. To compare neuropsychological performance across groups, five separate MANCOVAs with follow-up univariate f-tests and simple contrasts were performed on WCST, COWA, Stroop Color-Word Test, Porteus Maze test, and MFFT, respectively. Lower scores reflect poorer performance, except on measures of impulsivity (i.e., average time to response on the MFFT 1 and 2 and deductions on the Porteus Mazes), where the opposite is true. Because they were grouped into different function categories, Trails A and B were analyzed in separate ANCOVAs.

Results

Demographic Data

The three groups did not differ significantly on ethnicity, but they did differ on education, age, and gender. Regarding ethnicity, data were missing on 17 subjects. The remaining sample of 171 subjects included 40 (23.4%) African Americans, 65 (38%) Caucasians, 51 (29.8%) Hispanics, 8 (4.7%) Asians, and 7 (4.1%) subjects of other ethnicities. The pedophilia and opiate addiction groups were older than controls (38.63 ± 12.2 vs. 44.58 ±

6.4 vs. 33.81 ± 9.7 years of age, respectively) (F[2.180] = 19.68, $p < 0.001$) and less educated (12.50 ± 3.6 vs. 11.96 ± 2.6 vs. 15.39 ± 2.0 years of education, respectively) (F[2,180] = 31.87, $p < 0.001$). While the subjects with pedophilia were younger than opiate addicted participants, the two groups did not differ on education. The pedophilia group was also significantly different from the other groups in terms of gender ($X^2 = 17.6$, $p < 0.001$); all the pedophilic subjects were male, whereas females comprised 22.6% of control subjects and 30.8% of subjects with opiate addiction.

Neither age nor gender were significantly associated with the composite neuropsychological score (r = -0.093, $p = 0.216$; F[1,185] = 0.082, $p = 0.775$, respectively). Education, however, was significantly correlated with the compound score (r = 0.210, $p = 0.005$) and was therefore entered into all later analyses as a covariate.

Cognitive Flexibility and Set-Switching

The WCST and Trails Making Test Part B were used to assess cognitive flexibility and set-switching ability (Table 1). By MANCOVA, the three groups did not significantly differ on the WCST (Wilk's λ [8,108] = 0.87, $p = 0.433$). However, the groups did differ by univariate f-test on the WCST Total correct score (F [3,60] = 4.92, $p = 0.004$); but not on the other three WCST scores (total errors, percent errors, and perseverative responses). By simple contrasts, controls differed significantly from subjects with pedophilia and marginally from subjects with opiate addiction on the total correct score.

By ANCOVA, groups significantly differed on the Trails B score (F[3,113] = 3.27, $p = 0.024$), but there were no group differences by paired contrasts.

Sustained Attention

Stroop Color-Word Test and Trail-Making Test Part A were used to compare sustained attention across groups (Table 1). By MANCOVA, Stroop scores differed significantly across groups (Wilk's λ [8,310] = 0.903, $p = 0.042$), with three of the four scores also differing significantly by univariate f-tests (Stroop Word, Stroop Color-Word, and Stroop Interference). Stroop Color marginally differed across groups. Opiate addicted subjects performed significantly worse than controls on Stroop Interference and marginally worse on Stroop Color Word. Subjects with pedophilia scored worse than controls on Color-Word.

There was a significant group difference by ANCOVA on the Trails A Test (F[3,115] = 4.13, $p = 0.008$), but no pairwise differences.

Impulsivity

The MFFT and Porteus Mazes were used to assess impulsivity in the three subject groups (Table 1). MFFT did not significantly differ by MANCOVA, but by univariate *f-tests* the groups differed significantly on two of the four MFFT scores and marginally differed on the other two scores. Simple contrasts showed that subjects with pedophilia had longer latency to response on both MFFT 1 and MFFT 2 than either controls or opiate addicted subjects.

The four scores on the Porteus Mazes differed across groups by MANCOVA (Wilk's λ [4,82] = 0.423 $p = 0.008$), with two of its four subscales (deductions and maximum correct) significantly differing by univariate f test. By simple contrasts, subjects with opiate addiction made significantly more mistakes than those with pedophilia or healthy controls (deductions), but subjects with pedophilia completed fewer mazes than the other two groups (maximum correct).

Verbal Fluency

COWA was the sole instrument used to assess verbal fluency (Table 1). COWA scores did not differ across groups by MANCOVA, although by univariate f test, the total number of correct responses did differ across groups. However, there were no significant two-group contrasts.

Discussion

Key Findings

In order to explore the utility of a behavioral addiction model of pedophilia, a sample of subjects with pedophilia, detoxified subjects with opiate addiction, and healthy controls were compared on a battery of executive function tests. As executive function is robustly associated with behavioral control, similarities and differences across groups may shed light on the mechanisms underlying pathological behavior within behavioral and chemical addictions. This study adds to the relatively sparse literature on the neuropsychology of pedophilia. To our knowledge, it is also the first study to explore executive function in pedophilia in light of a behavioral addiction model.

Our study found that both subjects with pedophilia and those with opiate addiction demonstrated impairment relative to controls on a variety of executive function tests. Subjects with pedophilia demonstrated impairment relative to controls on tests of cognitive flexibility and set switching (WCST) and sustained attention (Stroop). They also showed abnormalities on both tests of impulsivity (MFFT and Porteus Mazes), but their impairment seems to reflect processing difficulties more than cognitive impulsivity (i.e., longer response latencies rather than shorter ones). Opiate addicted subjects demonstrated impairment on sustained attention (Stroop) and marginal impairment on cognitive flexibility (WCST). They also had more errors on Porteus Mazes, a test of impulsivity. Subjects with pedophilia differed from those with opiate addiction on several tests, with longer latency to response on MFFT and fewer completed mazes but also fewer errors on Porteus Mazes. One interpretation of these findings is that subjects with pedophilia were less prone to errors of impulsivity than were those with opiate addiction. Thus, while both subjects with pedophilia and opiate addiction show executive dysfunction, the nature of that dysfunction may differ between the two groups.

That both groups showed impairment on executive function tests is consistent with previous literature. Individuals with opiate addiction have shown impairment on numerous neuropsychological tests, including Porteus Mazes, WCST, the Gambling Task, and the Stroop.[10,11,25,37] The neuropsychological literature on pedophilia is not as robust, but individuals with pedophilia have previously demonstrated executive dysfunction,[13,20] lowered IQ,[12,14] abnormal verbal fluency,[15] and global impairment on neuropsychological tests.[12] Our study also suggested that opiate addicted subjects may perform worse than those with pedophilia on tests sensitive to cognitive impulsivity. To our knowledge, this finding has not be shown in prior literature; however, it is consistent with our previous work, in which we found that subjects with opiate addiction had higher levels of impulsive personality traits than those with pedophili.[30]

It is important to note that addictive pathology is not equivalent to impulsivity. While impulsive traits have been shown in many addictive groups,[30,38] the constructs of impulsivity and addiction are quite distinct. Impulsivity is generally seen to reflect the failure to inhibit pleasurable behavior due to inadequate consideration of consequences.[7,8,39] This impairment in behavioral inhibition is associated with orbito-frontal and serotonergic function.[9] In contrast, addictive processes reflect abnormal reward function or goal-driven behavior. The strength of the desire for the reward overwhelms inhibitory function. This

motivational impairment is associated with the mesolimbic dopaminergic reward circuitry, particularly in the nucleus accumbens.[39] Conceivably, executive dysfunction in pedophilia may relate more to abnormal reward function than to inhibitory failure per se, while addictive pathology in opiate addiction may involve both processes.

Likewise, we can speculate that impairment in cognitive flexibility, as shown in both groups' performance on the WCST, may contribute to fixation on a specific goal. Thus, difficulty in changing sets could underlie the inability to modulate desire for the object of addiction. Indirect support for this hypothesis comes from imaging research showing blunted response of the dopaminergic reward circuitry for rewarding stimuli other than the object of addiction.[40] A related finding is that the fairly robust group differences on the Stroop Test suggest deficits in sustained attention in both groups. Deficits in sustained attention may complement problems with cognitive inflexibility, in that there is impaired ability to direct attention and resist distraction from salient stimuli. Conceivably, similar cognitive tendencies might contribute to difficulty directing attention away from powerful reward cues. Thus, there may be a relationship between both cognitive inflexibility/impairment in directed attention and fixation on specific rewards. Consistent with this hypothesis, dopaminergic tracts have been implicated in complex attentional processes and dopaminergic agonists are used to treat attention-deficit/hyperactivity disorder (see Farrow et al,[41] for a review). The hypothesis of a relationship between cognitive inflexibility/ impairment in directed attention and dysregulated reward function is intriguing and could be tested in future research, for example, by correlating WCST and Stroop scores with measures of craving.

Implications for Treatment

The results presented here may also suggest implications for treatment. Cognitive dysfunction has previously been associated with relapse and poor treatment outcome,[42] and cognitive remediation has been used in the treatment of substance use disorders.[43] It is of interest whether cognitive remediation focused on increasing cognitive flexibility and directed attention might be of use in the treatment of addictive craving.

Limitations and Directions for Future Research

The results of this study should be considered within the context of the study's limitations. Our sample size varied across different tests, and the groups were not matched for several demographic variables, although such differences were accounted for statistically. In addition, within the opiate addiction group, cognitive impairment may or may not have predated the onset of opiate addiction. It is unlikely, however, that our results are confounded by the acute effects of drugs of abuse, as all of our opiate addicted subjects were detoxified from methadone and any illicit substances for at least 6 months and had repeated clean urine toxicology tests prior to the study. Of note, while the opiate addicted subjects had been detoxified from methadone, both clinical groups were in active treatment and presumably abstinent at the time of testing. Additionally, our pedophilic sample was also recruited from an outpatient clinic and thus may not be representative of individuals with pedophilic urges who have not acted on those urges, have not been caught, or are currently incarcerated. Finally, it is possible that not all of our pedophilic subjects met DSM-IV-TR criteria for pedophilia, so that some of our subjects could be classified as non-pedophilic child molesters. However, of the 29 subjects for whom we had information on their pedophilic behavior, 17 (59%) admitted to more than one victim and 48% admitted to 10 or more pedophilic acts or victims. According to the proposed draft revisions for DSM-V, child molesters with two or more victims will meet criteria for pedophilia under DSM V.[44] Further, given the demonstrated heterogeneity in pedophilic activity among pedophilic

samples,[45] our sample is likely to be representative of outpatient clinics treating individuals who desire or have engaged in sexual activity with children.

Within these limitations, however, this study provides new information about cognitive function in both pedophilic and opiate addicted subjects. To our knowledge, this is the first study to directly compare neuropsychological performance in subjects with pedophilia and opiate addiction. If replicated in larger and demographically matched samples, such findings could potentially shed light on the relationship between behavioral and chemical addictions and suggest new directions for treatment.

Acknowledgments

This study was supported by NIDA grant # R01 DA 12273 (to Dr. Galynker), the NIDA Intramural Research Program, and the Counterdrug Technology Center, Office of National Drug Control Policy.

We would like to acknowledge the contributions of Steven Frenda, M.A., Ken Cullen, MSW, Enid Gertmenian-King, MSW, and Alisa Turok, MD.

References

1. Hanson RK, Steffy RA, Gauthier R. Long-term recidivism of child molesters. J Consult Clin Psychol. 1993; 61:646–52. [PubMed: 8370860]
2. Maletzky BM. Factors associated with success and failure in the behavioral and cognitive treatment of sexual offenders. Sex Abuse. 1993; 6:241–58.
3. Seto, MC. Pedophilia and sexual offending against children: Theory, assessment, and intervention. Washington, DC: American Psychological Association; 2008.
4. American Psychiatric Association. DSM-V development: Substance-related disorders. (available at www.dsm5.org/proposedrevisions/pages/substance-relateddisorders.aspx
5. Carnes, P. Don't call it love: Recovery from sexual addiction. New York: Bantam Books; 1991.
6. Goodman, A. Sexual addiction: An integrated approach. Madison CT: International Universities Press; 1998.
7. Cohen, LJ. The neurobiology of antisociality. In: Stough, C., editor. Neurobiology of exceptionality. New York: Springer; 2005. p. 107-24.
8. Oldham, J.; Hollander, E.; Skodol, A. Impulsivity and compulsivity. Washington, DC: American Psychiatric Press; 1996.
9. Coccaro EF, Siever LJ, Klar HM, et al. Serotonergic studies in affective and personality disorder patients: Correlations with behavioral aggression and impulsivity. Arch Gen Psychiatry. 1989; 46:587–99. [PubMed: 2735812]
10. Prosser J, Cohen LJ, Steinfeld M, et al. Neuropsychological functioning in opiate-dependent subjects receiving and following methadone maintenance treatment. Drug Alcohol Depend. 2006; 84:240–7. [PubMed: 16545923]
11. Lee TM, Pau CW. Impulse control differences between abstinent heroin users and matched controls. Brain Inj. 2002; 16:885–9. [PubMed: 12419001]
12. Langevin R, Wortzman G, Wright P, et al. Neuropsychological impairment in incest offenders. Annals of Sex Research. 1988; 1:401–15.
13. Langevin R, Wortzman G, Wright P, et al. Studies of brain damage and dysfunction in sex offenders. Annals of Sex Research. 1989; 2:163–79.
14. Cantor JM, Blanchard R, Robichaud LK, et al. Quantitative reanalysis of aggregate data on IQ in sexual offenders. Psychol Bull. 2005; 131:555–68. [PubMed: 16060802]
15. Flor-Henry P, Lang RA, Koles ZJ, et al. Quantitative EEG studies of pedophilia. Int J Psychophysiol. 1991; 10:253–8. [PubMed: 2010320]
16. Wechsler, D. Wechsler Adult Intelligence Scale-Revised. Psychological Corporation; 1981.
17. Reitan, RM.; Wolfson, D. The Halstead-Reitan Neuropsychological Test Battery. Tuscson: Neuropsychology Press; 1993.

18. Schiffer B, Paul T, Gizewski E, et al. Functional brain correlates of heterosexual paedophilia. Neuroimage. 2008; 41:80–91. [PubMed: 18358744]
19. Cohen LJ, Nikiforov K, Watras-Gans S, et al. Heterosexual male perpetrators of childhood sexual abuse: A preliminary neuropsychiatric model. Psychiatr Q. 2002; 73:313–35. [PubMed: 12418359]
20. Tost H, Vollmert C, Brassen S, et al. Pedophilia: Neuropsychological evidence encouraging a brain network perspective. Med Hypotheses. 2004; 63:528–31. [PubMed: 15288382]
21. Suchy Y, Whittaker JW, Strassberg DS, et al. Neurocognitive differences between pedophilic and nonpedophilic child molesters. J Int Neuropsychol Soc. 2009; 15:248–57. [PubMed: 19203438]
22. Cohen LJ, Galynker I. Psychopathology and personality traits of pedophiles: Issues for diagnosis and treatment. Psychiatr Times. 2009; 26:25–30.
23. Haywood TW, Kravitz HM, Wasyliw OE, et al. Cycle of abuse and psychopathology in cleric and noncleric molesters of children and adolescents. Child Abuse Negl. 1996; 20:1233–43. [PubMed: 8985613]
24. Bechara A, Damásio AR, Damásio H. Insensitivity to future consequences following damage to human prefrontal cortex. Cognition. 1994; 50:7–15. [PubMed: 8039375]
25. Grant S, Contageggi C, London ED. Drug abusers show impaired performance in a laboratory test of decision making. Neuropsychologia. 2000; 38:1180–87. [PubMed: 10838152]
26. Porteus, S. The Porteus maze test and intelligence. Palo Alto: Pacific Books; 1950.
27. MacLeod CM. Half a century of research on the Stroop effect: An integrative review. Psychol Rev. 1991; 109:163–203.
28. Davis PE, Liddiard H, McMillan TM. Neuropsychological deficits and opiate abuse. Drug Alcohol Depend. 2002; 67:105–8. [PubMed: 12062785]
29. Verdejo A, Toribio I, Orozco C, et al. Neuropsychological functioning in methadone maintenance patients versus abstinent heroin abusers. Drug Alcohol Depend. 2005; 78:283–8. [PubMed: 15893159]
30. Cohen LJ, Grebchencko YF, Steinfeld M, et al. Comparison of personality traits in pedophiles, abstinent opiate addicts, and healthy controls: Considering pedophilia as an addictive behavior. J Nerv Ment Dis. 2008; 196:11.
31. Cohen LJ, Watras-Gans S, McGeoch P, et al. Impulsive-aggressive personality traits in male pedophiles: Is pedophilia an impulsive-aggressive disorder? Compr Psychiatry. 2002; 43:127–34. [PubMed: 11893991]
32. Loonstra AS, Tarlow AR, Sellers AH. COWAT metanorms across age, education, and gender. Appl Neuropsychol. 2001; 8:161–6. [PubMed: 11686651]
33. Kagan J. Reflection, impulsivity and reading ability in primary grade children. Child Dev. 1965; 36:609–28.
34. Cairns FD, Cammock J. Development of a more reliable version of the Matching Familiar Figures Test. Dev Psychol. 1978; 5:555–60.
35. Heaton, RK.; Chelune, GJ.; Talley, JL., et al. Wisconsin card sorting test manual: Revised and expanded. Odessa, FL: Psychological Assessment Resources; 1993.
36. First, MB.; Spitzer, RL.; Williams, JBW., et al. Structured Clinical Interview for DSM-IV (SCID-I) (User's Guide and Interview) Research Version. New York: Biometrics Research Department, New York Psychiatric Institute; 1995.
37. Pau CWH, Lee TMC, Chan SF. The impact of heroin on frontal executive functions. Arch Clin Neuropsychol. 2002; 17:663–70. [PubMed: 14591849]
38. Brooner RK, King VL, Kidorf M, et al. Psychiatric and substance abuse comorbidity among treatment-seeking opioid addicts. Arch Gen Psychiatry. 1997; 54:71–80. [PubMed: 9006403]
39. Stein D, Black DW, Pienaar W. Sexual disorders not otherwise specified: Compulsive, addictive or impulsive? CNS Spectrums. 2000; 5:60–4. [PubMed: 18311101]
40. Garavan H, Pankiewicz J, Bloom A, et al. Cue-induced cocaine craving: neuroanatomical specificity for drug users and drug stimuli. Am J Psychiatry. 2000; 157:1789–98. [PubMed: 11058476]

41. Farrow, M.; Levy, F.; Silberstein, R. Neurobiology of ADHD. In: Stough, C., editor. Neurobiology of exceptionality. New York: Springer; 2005. p. 143-98.

42. Aharonovic E, Nunes E, Hasin D. Cognitive impairment, retention, and abstinence among cocaine abusers in cognitive-behavioral treatment. Drug Alcohol Depend. 2003; 71:207–11. [PubMed: 12927659]

43. Vocci FJ. Cognitive remediation in the treatment of stimulant abuse disorders: A research agenda. Exp Clin Psychopharmacol. 2008; 16:484–97. [PubMed: 19086769]

44. American Psychiatric Association. DSM-5 Development Website. Available at http://www.dsm5.org/Pages/Default.aspx

45. Abel GG, Osborne C. The paraphilias: The extent and nature of sexually deviant and criminal behavior. Psychiatr Clin North Am. 1992; 15:675–87. [PubMed: 1409028]

J Psychiatr Pract. Author manuscript; available in PMC 2011 November 1.

Table 1

Comparison of Neurocognitive Measures

	Pedophilia	Opiate Addiction	Healthy controls		
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Statistics**	**Simple Contrast**
Cognitive Flexibility and Set Switching					
Wisconsin Card Sort Test	n=22	n=20	n=22	Wilk's λ (8,108) = 0.87, p =0.433	
WCST total correct	76.23 ± 9.1	75.05 ± 9.3	68.59 ± 9.5	F (3,60) = 4.92, p = 0.004[c]	C < P,[b] OA[a]
WCST total errors	27.32 ± 17.1	29.00 ± 17.4	20.19 ± 18.9	F (3,60) = 1.46, p = 0.234	
WCST percent errors	24.64 ± 11.3	26.90 ± 12.5	20.38 ± 13.2	F (3,60) = 1.99, p = 0.125	
WCST perseverative responses	12.95 ± 8.1	15.29 ± 10.4	12.10 ± 12.9	F (3,60) = 0.49, p = 0.694	
Trail Making Test (TRAIL)	n=49	n=19	n=49		
TRAIL Part B	89.31 ± 41.0	89.58 ± 52.4	86.51 ± 57.5	F (3,113) = 3.27, p = 0.024[b]	
Sustained Attention					
STROOP Color Word Test	n=47	n=50	n=80	Wilk's λ (8,310) = 0.903, p = 0.042[b]	
STROOP Word	90.66 ± 22.6	87.86 ± 16.5	97.66 ± 15.2	F (3,161) = 7.12, p < 0.001[d]	
STROOP Color	66.30 ± 16.6	67.50 ± 11.8	69.23 ± 12.4	F (3,161) = 2.28, p = 0.082[a]	
STROOP Color-Word	35.92 ± 11.1	35.78 ± 9.6	43.05 ± 10.5	F (3,161) = 10.78, p < 0.001[d]	C > P,[b] OA[a]
STROOP Interference	-1.03 ± 10.0	-2.16 ± 8.4	3.24 ± 9.0	F (3,161) = 4.56, p = 0.004[c]	C > OA[b]
Trail Making Test (TRAIL)	n=50	n=21	n=49		
TRAIL Part A	37.82 ± 18.7	33.71 ± 10.4	32.22 ± 13.7	F (3,115) = 4.13, p = 0.008[c]	
Verbal Fluency					
Controlled Oral Word Association (COWA)	n=49	n=49	n=70	Wilk's λ (4,316) =0.982, p=0.570	
COWA total correct	36.43 ± 10.7	34.78 ± 11.3	39.29 ± 10.3	F (3,162) = 4.55, p = 0.004[c]	
COWA total errors	2.59 ± 4.7	2.12 ± 2.0	1.56 ± 1.7	F (3,162) = 1.01, p = 0.391	
Impulsivity					
Matching Familiar Figure Test (MFFT)	n=24	n=23	n=24	Wilk's λ (8,124) =0.816, p=0.115	
MFFT-1 average time to first response	19.35 ± 12.9	12.77 ± 8.3	14.21 ± 7.6	F (3,68) = 2.29, p = 0.087 [a]	P > C,[b] OA[a]
MFFT-1 average number of responses	1.61 ± 0.6	1.65 ± 0.6	1.31 ± 0.3	F (3,68) = 4.23, p = 0.009[c]	

	Pedophilia	Opiate Addiction	Healthy controls		
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Statistics**	**Simple Contrast**
MFFT-2 average time to first response	41.55 ± 28.6	26.21 ± 24.2	28.79 ± 17.7	F (3,68) = 2.71, p = 0.053[b]	P > C,[b] OA[c]
MFFT-2 average number of responses	2.11 ± 0.6	2.30 ± 0.7	1.98 ± 0.6	F(.,68) = 2.71, p = 0.070[a]	
Porteus Mazes (PM)	n=24	n=15	n=11	Wilk's λ (4,82) = 0.423,p = 0.008[c]	
PM max correct	15.46 ± 2.3	17.00 ± 0.0	17.00 ± 0.0	F (3,47) = 3.90, p = 0.015[b]	P < C,[b] OA[c]
PM deductions	1.29 ± 1.1	3.03 ± 1.6	1.36 ± 1.1	F (3,47) = 3.46, p = 0.024[b]	OA > C,[b] P[c]
PM test age	14.13 ± 2.4	13.97 ± 2.6	15.64 ± 1.1	F (3,47) = 1.13, p = 0.349	
PM total qualitative score	21.42 ± 22.4	28.07 ± 16.1	15.55 ± 23.0	F (3,47) = 1.04, p = 0.385	

Note for Table 1:

[a] p ≤ 0.10,

[b] p ≤ 0.05,

[c] p ≤ 0.01,

[d] p ≤ 0.001

P: subjects with pedophilia; OA: subjects with opiate addiction; C: normal controls; SD: standard deviation