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Executive functioning profiles of adult and juvenile male sexual offenders: A systematic review

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ABSTRACT

Evidence regarding biological correlates of sexual offending, which might enhance the understanding, research, and treatment of these offenders, is rather emerging or in the embryonic stage. In this study, our main objective is to identify specific executive functioning (EF) processes that are commonly impaired in sexual offenders, and to further determine whether these differ as a function of offender subtypes. A search is conducted in *ProQuest*, *Criminal Justice Abstract*, *EBSCOhost*, and *Social Science Citation Index* electronic journal databases for studies published spanning the period 1990–2015. Google Scholar and Google search engines were also searched and the reference lists of the retrieved papers were searched for additional papers. A total of 1303 papers were retained for consideration. After removing duplicates, and subjecting the retrieved papers to inclusion and exclusion criteria, 24 papers (19 published and 5 unpublished) were deemed appropriate for the review. While several EF processes have been investigated, the available evidence implicates deficits in *cognitive flexibility* and *inhibition of interference* as commonly reported among adult male sexual offenders. This finding may be due to the sensitivity of tests of *cognitive flexibility* (e.g. the Wisconsin Card Sorting Test) and *inhibition of interference* (e.g. the Stroop Test) to frontal lobe lesions, and also because these tests are among the most frequently administered EF tests as revealed by this study. Juvenile sexual offenders, however, exhibit no distinct EF profiles. The findings of the study, implications for treatment, and recommendations for future studies are succinctly discussed.

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Introduction

Sexual offenses, just like other offenses against the person (e.g. murder and assault), are not only despicable, but also threaten public safety and security.

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Research efforts have focused on delineating the risk factors which when meaningfully intervened can contribute to reduce sexual crimes and sexual offender recidivism (e.g. Abracen, O'Carroll, & Ladha, 1991; Chan & Beauregard, 2015; Cohen et al., 2002; Fazel, O'Donnell, Hope, Gulati, & Jacoby, 2007; Kelly, Richardson, Hunter, & Knapp, 2002; McLeod, 2015; Sigre-Leirós, Carvalho, & Nobre, 2015; Stone & Thompson, 2001; Suchy, Whittaker, Strassberg, & Eastvold, 2009; Young, Justice, & Erdberg, 2012). These empirical investigations have suggested that sexual offending is a complex phenomenon likely to result from changes in an individual's biological, psychological, and social dynamics. Although psychosocial risk factors (e.g. childhood sexual abuse and maltreatment) have been well investigated (e.g. Levenson, Willis, & Prescott, 2015), evidence regarding biological correlates of sexual offending, which might enhance the understanding, research, and treatment of these offenders, is rather emerging or in the embryonic stage.

The first-ever meta-analytic study of neuropsychology of sexual offenders by Joyal, Plante-Beaulieu, and de Chanterac (2014) found that these offenders showed overall neuropsychological impairment than noncriminal controls (Cohen's $d = .59$), and non-sex offenders (Cohen's $d = .28$). Of interest, when the groups were compared in terms of their performance in executive functioning (EF), the sexual offenders reported significant deficits than the noncriminal controls, but not more than the non-sex offenders. This meta-analytic investigation has added to the repertoire of empirical knowledge on the possible involvement of neuropsychological deficits in the tendency to engage in sexual deviant behaviors. This notwithstanding, although the Joyal et al. (2014) primarily aimed 'to define specific subgroups of sex offenders and to demonstrate that they present with distinct cognitive profiles ... it was not possible for us [i.e. Joyal et al., 2014] to achieve this goal' (p. 167). This was largely due to the heterogeneous nature of the individual studies included in the meta-analysis.

Nevertheless, the authors successfully demonstrated that sexual offenders were grossly impaired in EF than noncriminal comparison groups. However, what remain elusive or unclear in this interesting meta-analytic investigation is the EF processes that are commonly impaired in sexual offenders and specifically in sexual offender subtypes so as to be targeted or prioritized both in treatment and research. Indeed, sexual offenders are a heterogeneous group of offenders who might differ in EF profile (see Chan & Heide, 2009; Joyal et al., 2014). Importantly, EF encompasses several abilities which might relate differentially to sexual offenses, thus, it would be insightful and informative to understand whether sexual offender subtypes can be differentiated based on specific or a set of EF deficits. Moreover, it has long been established that there are significant and obvious neurodevelopmental differences in EF abilities between adults and adolescence (for a review, see Jurado & Rosselli, 2007). Yet, it is unknown whether adult and juvenile sexual offenders differ in their presentations of EF deficits.

Likewise, whether male and female offenders can be distinguished by unique EF profiles or whether they exhibit similar or same EF profile is largely unknown.

Insights into these issues are particularly important both to advance the understanding of EF in sexual offenders and direct research and clinical efforts (i.e. assessment and treatment). For instance, researchers would be able to focus their investigative efforts on EF deficits that are commonly and perhaps strongly associated with sexual offenses. Clinical endeavors to rehabilitate EF deficits can also be directed at specific EF deficits. The nature or type of EF deficits can similarly open novel and innovative treatment programs. Again, from clinical perspective, knowledge about the EF domain frequently implicated in sexual offending can equally ensure accurate and valid assessment of EF deficits in these offenders, thereby enhancing diagnosis and treatment. This can further facilitate the possible use of EF in risk assessment of sexual offenders.

By way of expanding upon Joyal et al.'s (2014) study and to further contribute to the burgeoning literature, the main objective of the present study is to identify specific EF processes that are commonly impaired in sexual offenders, and to further determine whether these deficits differ as a function of offender subtypes (e.g. pedophiles), gender, and age (i.e. adults, and juveniles). An additional goal is to critically review issues associated with EF test administration in sexual offender research and consequently to proffer recommendations that could help ensure best practices in the field. We reviewed the various studies to (1) identify EF profiles in these offenders, (2) commonly administered EF tests, and (3) issues associated with the administrations of these tests. We focused largely on EF because deficits in this neurocognitive domain have been strongly implicated in antisocial and criminal behaviors in general (for meta-analytic review, see Morgan & Lilienfeld, 2000; Ogilvie, Stewart, Chan, & Shum, 2011). Besides, EF deficits are amenable to treatment or interventions (Rocha, Marques, Fortuna, Antunes, & Hoaken, 2014). Therefore, insight into the EF deficits that underpin sexual offenses and subsequently mitigating these deficits can help reduce the risk of sexual recidivism, especially given that rehabilitating these deficits (e.g. behavioral inhibition) can promote engagement in and completion of psychosocial-oriented treatment programs (e.g. cognitive therapy, and cognitive behavior therapy) by offenders (Fishbein et al., 2009). In the section that follows, we provide a brief overview of the concept of EF, and its anatomical correlates.

The concept of EF

Currently, there is no universally agreed-upon definition of EF as the term has been variously defined. Yet, there is some relative agreement that EF is a description of a complex set of executive processes (for a detailed review, see Alvarez & Emory, 2006; Jurado & Rosselli, 2007). Lezak, Howieson, Bigler, and Tranel (2012) identified four components of EF as: (1) volition (i.e. evaluating one's

needs and adopting measures to achieve them); (2) planning (i.e. identify steps necessary to achieve some desired goals); (3) purposive action (i.e. translating intention or plan into productive and self-serving activity); and lastly (4) effective performance (i.e. ability to monitor, self-correct and regulate the performance of an act). Other EF domains include resistance to distraction and interference, self-monitoring, attention, cognitive flexibility, goal setting, abstract reasoning, decision-making and risk evaluations, setting and prioritizing actions and goals, and coping with novel situations (Hargrave, Nupp, & Erickson, 2012; Miyake & Friedman, 2012). EF abilities, which emerge in childhood and start to decline in old age (see Jurado & Rosselli, 2007), undergird the performance of almost all human daily activities (Maes, Eling, Reelick, & Kessels, 2011; Snyder, Miyake, & Hankin, 2015). They are also generally relevant for socially responsible and appropriate adult conducts (Lezak et al., 2012).

EF is widely known to be mediated by the frontal lobe, specifically the prefrontal cortex (PFC), although other neuroanatomical structures (e.g. posterior parietal cortex) play some minor roles (see Nee, Wager, & Jonides, 2007). The bony protuberances of the frontal lobe augment its susceptibility to injury (Ylvisaker & DeBonis, 2000), partly explaining why the frontal lobe is frequently involved in traumatic brain injury (TBI) (Bauman Johnson, Maricle, Miller, Allen, & Mayfield, 2010). In addition, the rich neuronal interconnectivity between the PFC and other brain regions (Stuss, 2011) also makes it possible for individuals to exhibit EF impairment even without a direct injury to the PFC. Although the brain can be injured via several processes, including prenatal (e.g. maternal stress) and perinatal factors (e.g. prolonged labor), acquired brain injury, especially TBI, remains a major public health and socioeconomic threat, globally (Bruns & Hauser, 2003; Corrigan, Selassie, & Orman, 2010; Roozenbeek, Maas, & Menon, 2013). Recent meta-analytic studies have shown that nonsexual offenders, including juveniles, have high prevalence rates of TBI (Farrer, Frost, & Hedges, 2013; Shiroma, Ferguson, & Pickelsimer, 2010), even when compared with the general population (Farrer & Hedges, 2011).

In sexual offenders specifically, studies have found that pedophilic men referred for clinical assessment of their sexual behaviors reported having suffered head injuries before their 13th birthday, compared with nonpedophilic men (Blanchard et al., 2002, 2003). In another study, the incidence of head injury in sexual offenders led to the conclusion that the sequelae of TBI are a significant etiological factor for sexual offenses (Simpson, Blaszczyński, & Hodgkinson, 1999). The high likelihood of involvement of the frontal lobe or its connections in brain injuries may account for EF deficits in nonsexual offenders (see Ogilvie et al., 2011) and sexual offenders. Some early researchers such as Flor-Henry (1987) hypothesized that damage to fronto-temporal area and the corresponding deficits in EF and verb ability account for sexual deviant behaviors. Unsurprisingly, studies examining neurocognitive correlates in sexual offending have tended to adopt measures that are purportedly sensitive to

PFC or fronto-temporal lesions (e.g. Becerra-García & Egan, 2014; Cohen, Nesci, Steinfeld, Haeri, & Galynker, 2010; Eastvold, Suchy, & Strassberg, 2011; Fazel, O'Donnell, et al., 2007; Gillespie & McKenzie, 2000; Kruger & Schiffer, 2011; Miyaguchi & Shirataki, 2015; Morais, Joyal, Alexander, Fix, & Burkhart, 2015; Schiffer et al., 2007; Spinella, White, Frank, & Schiraldi, 2006; Stone & Thompson, 2001; Veneziano, Veneziano, LeGrand, & Richards, 2004; Young, Justice, & Edberg, 2010). As previously noted, given the purported involvement of EF deficits in sexual offenses, the present study examines the nature or profile of EF deficits in adult and juvenile (male) sexual offenders. The study further aims to identify issues pertaining to the administration of EF tests.

Methods

Three different methods were employed to obtain relevant papers for the review. First, a search was conducted in the following electronic journal databases: *ProQuest*, *Criminal Justice Abstract*, *EBSCOhost*, and *Social Science Citation Index*. A search in *ProQuest* enabled access to *PsychInfo*, *PsychARTICLES*, *ProQuest Dissertations & Theses*, and *ProQuest Social Science Journals* (1434 independent journals) such as *American Journal of Psychology*, *Archives of Sexual Behavior*, *The British Journal of Criminology*, *Canadian Journal of Criminology and Criminal Justice*. A search in *EBSCOhost* database also granted access to life and health sciences database such as *Medline*, and *Social Sciences* databases. To simplify and ensure comprehensive search and retrieval processes while at the same time reducing the explosion of irrelevant studies that often accompany the use of more than two search terms concurrently, the present study used two search terms in each search. The search terms included neuropsychology, neurocognitive function, executive function, frontal lobe, and prefrontal cortex which were crossed with sex offenders, pedophile, sexual deviance, rape or rapist, paraphilia, adult sex offenders, juvenile sex offenders, adolescent sex offenders, and youth sex offenders. All studies published in 1990 and prior to 31 May 2015 and available electronically were considered. Appendix 1 summarizes the search process and the number of hits for each search strategy and each database. Second, Google Scholar and Google search engines were searched for both published and unpublished materials (i.e. grey literature). Thirdly, the reference lists of the retrieved papers as well as Joyal et al. (2014) meta-analytic paper were consulted for additional papers. To be included in the review, studies must have: (1) used sexual offenders and comparison group(s); (2) compared the groups above on at least one measure of EF; and (3) English as the language of publication. The exclusion criteria were: (1) studies that have examined the relationship between EF and other measures (e.g. maltreatment, psychopathy, personality); (2) studies that have aggregated EF and other neurocognitive function scores as estimates of neuropsychological functioning; and (3) reviews, opinion, and discussion papers well as meta-analytic investigations.

Results

A total of 1298 papers were returned from the journal databases, two papers were obtained from Google Scholar and Google Searches, one from the reference lists of the retrieved papers, and two from Joyal et al. (2014) study, yielding a total of 1303 papers for consideration. Duplicates were removed, leaving a total of 794 papers. Of this number, only 80 papers were retained after the initial screening in line with the focus on the study. These papers were subsequently subjected to the inclusion and exclusion criteria by reviewing their abstracts and the full text, where necessary. A total of 24 (19 published and 5 unpublished) papers were deemed appropriate for the review. Of this number, 18 investigated adult male sexual offenders (pedophiles or child molesters, $n = 11$, undifferentiated sexual offenders, $n = 7$), and six investigated juvenile male sexual offenders. The only study of adult female sexual offenders by Pflugradt and Allen (2010) was excluded for lack of a comparison group. Majority of the studies on adult male sexual offenders were conducted in North America (the United States, $n = 9$, Canada, $n = 2$), Europe (Germany, $n = 2$, United Kingdom, $n = 1$, Spain, $n = 1$), and lastly Asia-pacific region (Australia, $n = 2$; Israel, $n = 1$). Three studies of juvenile sexual offenders were conducted in the United States, one each in Canada, the United Kingdom, and Japan. Notably, sample size ranged from 12 to 60 for studies of pedophiles and child molesters, 8–68 for uncategorized sexual offenders, and 20–127 for juvenile sexual offenders. Please, refer to Tables 1–3 for information on the characteristics as well as summaries of the findings of the studies. In the next sections, we briefly described the EF profiles of sexual offenders, as were stated or referred to by the study authors.

Executive function profiles of adult male sexual offenders: pedophiles/child molesters

Abracen et al. (1991) conducted a study in Canada and found that 12 child molesters and comparison groups (prisoners and noncriminal group) do not differ significantly in their performance in *visuo-spatial problem-solving* and *cognitive flexibility*. Yet, it is interesting to note that subsequent studies conducted in North America have reported findings contrary to those of Abracen et al. (1991). Illustrating, Martin (1998) investigated EF in 35 pedophiles and rapists in the United States, using noncriminal individuals as the comparison group. The results showed that the sexual offenders exhibited significant deficits in *immediate and delayed recall and delayed recognition*, and *cognitive flexibility* than the control group. Comparison of the sexual offenders further showed that the pedophiles were significantly impaired in *delayed recall, attention and concentration*, and *visual/spatial ability* than the rapists. Joyal, Black, and Dassylva (2007) similarly studied Canadian 25 sexual offenders (pedophiles and rapists) and reported that pedophiles performed significantly poorer on measures of

Table 1. Summary of studies investigating EF in adult male sexual offenders –pedophiles and molesters.

Author/ year	Country	Sexual offenders	Comparison group	Executive function test	Summary of findings
Martin (1998)*	United States	35 male sexual offenders (pedophiles and rapists)	Noncriminals	CVLT, Category Test, COWAT, WCST, TMTA & B, VIGIL, Rey Complex and Recognition Test, Folstein Mini mental Status Test	<ul style="list-style-type: none"> Sexual offenders showed poorer performance in verbal learning, verbal fluency, immediate and delayed recall and delayed recognition, and cognitive flexibility than noncriminal group Pedophiles performed poorer in delayed recall, attention and concentration, visual/spatial ability, and learning than rapists
Suchy et al. (2009)	United States	20 pedophilic and 20 non-pedophilic child molesters	20 male noncriminals	The Stroop test, Ruff Figural Fluency Test, Behavioral dyscontrol scale	<ul style="list-style-type: none"> Pedophilic and nonpedophilic molesters performed more poorly in EF composite score than noncriminal group
Cohen et al. (2010)	United States	51 male pedophiles	53 males and females with opiate addiction, 84 male and female healthy group	WCST, TMT, Stroop Test, Porteus Mazes, Matching Familiar Figures Test, COWAT	<ul style="list-style-type: none"> Pedophiles showed deficits in cognitive flexibility, and poor sustained attention than noncriminal group No difference between pedophiles and controls and noncriminal group in verbal fluency
Eastvold et al. (2011)	United States	30 Pedophilic and 30 nonpedophilic child molesters (Males)	29 nonsexual criminal offenders	Delis Kaplan Executive Function System (DKEFS)	<ul style="list-style-type: none"> No significant difference between sex offenders and nonsexual criminal offenders in EF composite score Pedophiles and non-pedophiles performed better than nonsexual criminal offenders in abstract reasoning, but poorly in inhibition Pedophilic performed better than non-pedophilic in planning Rape offenders, compared with molest offenders, showed significant impairment in attention, distractibility, impulse control, sustain attention, cognitive flexibility, reasoning, planning, anticipate consequences of actions
Young et al. (2012)	United States	15 male molest offenders	45 male rape offenders	WCST, TMTA & B, Seashore Rhythm Test, Category Test	<ul style="list-style-type: none"> Composite score of EF did not predict rape offenders from molest offenders No difference among the groups on EF tests
Abraçen et al., 1991	Canada	12 child molesters	12 prison controls, 12 noncriminals	TMTB, RCPM, WVLT	<ul style="list-style-type: none"> No difference among the groups on EF tests

(Continued).



Table 1. Continued.

Author/ year	Country	Sexual offenders	Comparison group	Executive func- tion test	Summary of findings
Joyal et al. (2007)	Canada	25 male sex offenders (pedophiles and rapists)	Normative sample accompanying the various tests	Stroop Test, COWAT, CVLT, WCST, TMTB	<ul style="list-style-type: none"> • Pedophiles performed poorer in the Stroop condition compared with the normative sample • Rapists and pedophiles performed poorly in verbal fluency than the normative sample. • Rapists and pedophiles do not differ in verbal fluency • Rapists and pedophiles performed poorly in verbal learning than the normative sample. • Pedophiles performed poorer than rapists in verbal learning • Sex offenders do not differ from normative sample in cognitive flexibility. • Pedophiles and rapists do not differ in cognitive flexibility • Pedophiles performed poorly in inhibition than noncriminal group and nonsexual offenders • Non-Pedophilic child molesters showed impaired cognitive flexibility than nonsexual offenders and noncriminal group • No significant difference between pedophiles and nonpedophiles • No significant difference between pedophiles and noncriminal group in cognitive flexibility
Schiffer & Vonlaufen (2011)	Germany	15 Pedophilic and 15 nonpedophilic child molesters (all males)	16 nonsexual offend- ers, 17 noncriminals	Computerized version Tower of London, Go/No-go, WCST, TMT	<ul style="list-style-type: none"> • Noncriminal group (14 heterosexual, and 14 homosexual) • 28 noncriminals
Kruger and Schiffer (2011)	Germany	9 male heterosexual and 11 male homosex- ual pedophiles	Noncriminal group (14 heterosexual, and 14 homosexual)	WCST	<ul style="list-style-type: none"> • Incestuous and nonincestuous offenders performed poorly in process- ing cognitive flexibility, and executive control than noncriminal offenders • Incestuous and nonincestuous offenders do not differ in processing speed, cognitive flexibility and executive control • Incestuous offenders showed impairment in working memory, com- pared with non-incestuous offenders and noncriminal group • No difference in performance in Category formation, set switching, visual attention, inhibition of interference
Becerra- García and Egan (2014)	Spain	21 Incestuous and 11 non-incestuous offenders	28 noncriminals	TMT, Digit span	
Cohen et al. (2002)	Israel	22 male pedophiles	24 male noncriminals	WCST, TMTA&B, Stroop Test	

Notes: CVLT = California Verbal Learning Test; COWAT = Controlled Oral Word Association Test; WCST = Wisconsin Card Sorting Test; TMT = Trail Making Test A and B; RCMP = Raven's Colored Progressive Matrices; WVL = Williams Verbal Learning Test.

*Unpublished papers.

Table 2. Summary of studies investigating EF in uncategorized adult male sexual offenders.

Author/year	Country	Sexual offenders	Comparison group	Executive function test	Summary of findings
Gillespie and McKenzie (2000)	United States	8 mentally disordered sexual offenders (male)	8 nonsexual offenders (male)	TMTB, Stroop Test, COWAT, RCPM	<ul style="list-style-type: none"> • No difference between the sexual offenders and nonsexual offenders
Stone and Thompson (2001)	United States	63 sexual offenders	Normative sample	CVLT, COWAT, WCST, TMT, Rey Complex Figure Test, Stroop Test, VIGIL	<ul style="list-style-type: none"> • Sexual offenders performed poorly in verbal fluency, learning new materials, visual-spatial ability, inhibition of interference, and attention and concentration
Spinella et al. (2006)	United States	21 sexual offenders	31 noncriminal controls	Go/No Go	<ul style="list-style-type: none"> • Sexual offenders were impaired in response inhibition than noncriminal control
Young et al. (2006)	United States	60 sexual offenders	60 nonsexual offenders	WCST	<ul style="list-style-type: none"> • Sex offenders impaired in cognitive flexibility
Deuthser (2004)*	Australia	25 sexual offenders	25 nonsexual offenders, 25 noncriminal males	Rey Complex Figure, WCST, COWAT	<ul style="list-style-type: none"> • No significance between the sex offenders and noncriminal control group in cognitive flexibility, inhibition of impulse and verbal fluency
Rodriguez (2014)*	Australia	32 first time (FT) adult (above 50 years of age) sexual offenders and 36 historical sexual offenders (HT; before age 50 years)	32 nonsexual offenders	Hayling test, TMTB, COWAT, The Iowa Gambling Task	<ul style="list-style-type: none"> • Nonsexual offenders outperformed FT and HT in response initiation, suppression, and verbal fluency • FT and HT do not differ in their performance in response initiation and suppression • FT impaired in verbal fluency than HT • No difference between sexual offenders and nonsexual offenders in decision making • Sexual offenders performed poorly in attention, concentration, resistance to distraction, and cognitive flexibility • No difference between the FT and HT in attention, concentration, resistance to distraction, and cognitive flexibility
Fazel et al. (2007)	United Kingdom	50 sexual offenders	50 nonsexual offenders	Verbal fluency test, Similarity test, test of copying and alternating sequence	<ul style="list-style-type: none"> • No group difference in EF composite score

Notes: CVLT = California Verbal Learning Test; COWAT = Controlled Oral Word Association Test; WCST = Wisconsin Card Sorting Test; TMT = Trail Making Test A and B; RCPM = Raven's Colored Progressive Matrices.

*Unpublished papers.

Table 3. Summary of studies investigating EF in juvenile male sexual offenders.

Author/ year	Country	Sexual offenders	Comparison group	Executive function test	Summary of findings
Miller (1997)*	United States	50 sexual offenders	50 nonsexual offenders	WCST	<ul style="list-style-type: none"> • No significant difference between the groups in cognitive flexibility
Rimmer (1998)*	United States	20 violent juvenile sexual offenders	20 violent nonsexual and 20 nonvi- olent juvenile offenders	COWAT, RCPM, TMTA & B	<ul style="list-style-type: none"> • EF deficits did not predict group membership in juvenile offenders
Veneziano et al. (2004)	United States	60 male adolescent sexual offenders	60 non delinquent adolescents	COWA, Tower of London, WCST, TMT	<ul style="list-style-type: none"> • Sex offenders performed poorly in visual conceptual and visuo-motor abilities than nonsexual delinquents • No differences between sex offenders and non-sex delinquents in problem solving and planning
Morais et al. (2015)	Canada	127 adolescent sexual offenders	56 nonsexual delinquent adolescents	Delis Kaplan Executive Function System (D-KEFS)	<ul style="list-style-type: none"> • No difference between sexual and nonsexual delinquent adolescents • Adolescent sex offenders with child victims performed significantly better than nonsexual delinquent in problem-solving, deductive reasoning, and cognitive flexibility • Adolescent sex offenders with peer-aged victims do not differ from nonsexual delinquents on EF profiles
Kelly et al. (2002)	United Kingdom	30 sexual offenders	20 male non- delinquent adolescents	TMT, WCST, Tower of London, COWAT	<ul style="list-style-type: none"> • Sexual offenders were impaired in EF factor score corresponding to focus-executive response speed and verbal fluency than noncriminal controls • No difference was found in motor organization, planning and strategy
Miyaguchi and Shirataki (2015)	Japan	55 male adolescent sexual offenders	155 nonsex- ual offenders	Behavioral Assessment of Dysexecutive Syndrome	<ul style="list-style-type: none"> • Sex offenders were significantly impaired in organization and planning profile score than non-sex offenders

Notes: COWAT = Controlled Oral Word Association Test; WCST = Wisconsin Card Sorting Test; TMT = Trail Making Test A and B; RCPM = Raven's Colored Progressive Matrices.

*Unpublished papers.

inhibition of interference, verbal fluency, and verbal learning than the normative sample. Rapists also showed significant deficits in *verbal fluency*, and *verbal learning* than the normative sample. Interestingly, when the authors compared pedophiles and rapists, with the exception of *verbal learning* in which pedophiles performed significantly poorer than rapists, there were no significant differences in their performances in *verbal fluency*, and *cognitive flexibility*. In a related study in the United States by Young et al. (2012), the results showed that albeit molest offenders and rapists ($n = 15$) were not significantly different in their performance in composite EF score, there were, however, differences in some EF abilities. Notably, contrary to previous findings (i.e. Joyal et al., 2007; Martin, 1998), rapists exhibited significant deficits in *attention, impulse control, cognitive flexibility, reasoning, and anticipation of consequences* than the molest offenders.

In another study in the United States, Suchy et al. (2009) reported that 20 pedophiles with primary sexual interest in prepubescent children and 20 that exhibited sexual interest in adults performed significantly poorly in EF composite score (e.g. *inhibition of interference* and *verbal fluency*) than the noncriminals. However, these two groups of pedophiles do not differ significantly in their performance in the EF composite score. Eastvold et al. (2011) similarly investigated EF in 30 pedophiles attracted to prepubescent children and 30 with interest in adults in the United States. In this study, whereas these two sexual offender groups do not differ significantly from non-sexual criminal offenders in EF composite scores, there were, however, significant differences in some individual EF profiles. Notably, even though the sexual offenders performed significantly better than the non-sexual criminal offenders in *abstract reasoning*, they were impaired in *inhibition of interference* than the non-sexual offenders. Moreover, comparison of the pedophile groups revealed that, with the exception of *planning deficits* that was significantly showed more in those with interest in prepubescent children than those attracted to adults, there were no other significant differences in EF abilities. In a related study in the United States, Cohen et al.'s (2010) found that, 51 pedophiles exhibited significant deficits in EF domains of *cognitive flexibility, and sustained attention* than noncriminal comparison group.

The results of the studies conducted in Europe appeared to show similar results with those reported in North America. For example, Schiffer and Vonlaufen (2011) reported on the EF profiles of 15 pedophiles with exclusive interest in prepubescent children and 15 pedophiles attracted to adults, in Germany. Consistent with previous studies (Eastvold et al., 2011; Suchy et al., 2009), the two groups of the child molesters revealed no significant differences in *attention shifting, cognitive flexibility, visuospatial ability, planning, and problem-solving*. Interestingly, the result further illustrated that pedophiles attracted to adults exhibited significant deficits in *cognitive flexibility*, relative to the non-criminal comparison group. In addition, when compared with noncriminal group and nonsexual offenders, pedophiles attracted to adults performed significantly poorly in *inhibition response*. In yet another study of Spanish child molesters by

Becerra-García and Egan (2014), the results showed that 21 incestuous (contact sexual offenses against family members) and 11 non-incestuous (contact sexual offenses against non-family members) child molesters performed significantly poorly in *cognitive flexibility* and *executive control*, compared with the noncriminal comparison group. However, the child molester groups (i.e. incestuous and non-incestuous) do not differ significantly in their performance in *processing speed*, *cognitive flexibility*, and *executive control*.

In contrast, a German study by Kruger and Schiffer (2011) reported no significant difference in *cognitive flexibility* among 9 homosexual pedophiles, 11 heterosexual pedophiles, and noncriminal group (i.e. homosexual and heterosexual). Cohen et al. (2002) study of pedophiles in Israel partly supports the finding of Kruger and Schiffer (2011). Accordingly, there was no statistically significant difference in the performance between 22 pedophiles and the non-criminal group in *category formation*, *set switching*, *visual attention*, as well as *inhibition of interference*.

In summary, studies across different geographical locations provide evidence that pedophiles or child molesters exhibited significant EF deficits relative to the comparison groups (Becerra-García & Egan, 2014; Cohen et al., 2010; Eastvold et al., 2011; Joyal et al., 2007; Martin, 1998; Schiffer & Vonlaufen, 2011; Suchy et al., 2009; Young et al., 2010). On the other hand, other studies reported no such evidence (Abracen et al., 1991; Cohen et al., 2002; Kruger & Schiffer, 2011). In general, child sexual offender subtypes do not differ in EF processes.

Of particular importance is whether pedophiles and child molesters can be distinguished by distinct and unique EF deficits. Although very difficult to pinpoint, it appears that impairments in two EF domains are reportedly common among pedophiles and child molesters, compared with the comparison group: (1) *cognitive flexibility* (e.g. Cohen et al., 2010; Martin, 1998; Schiffer & Vonlaufen, 2011; except Kruger & Schiffer, 2011); and (2) *inhibition of interference* (e.g. Eastvold et al., 2011; Joyal et al., 2007; Schiffer & Vonlaufen, 2011; except Cohen et al., 2002).

Executive function profiles of uncategorized adult male sexual offenders

This section discussed studies in which sexual offenders were not categorized based on the type of sexual offense (e.g. rapists). Gillespie and McKenzie's (2000) study in the United States revealed that 8 mentally disordered sexual offenders and 8 non-sexual offenders do not differ significantly in their performance in *attention* and *verbal ability*. However, subsequent studies conducted in the United States have shown that sexual offenders performed significantly poorer than the comparison groups. For example, Stone and Thompson's (2001) investigation indicated that 63 sexual offenders (e.g. pedophile, rapists, and exhibitionist) scored below 98% of the normative sample, indicating impairment in EF.

Specifically, sexual offenders, compared with the normative sample, exhibited significant deficits in *verbal fluency, visual-spatial ability, cognitive flexibility and/or perseveration, verbal learning and memory, response inhibition, attention, and concentration*. Similar finding was reported by Spinella et al. (2006). In this study, the 21 sexual offenders were reportedly impaired in *response inhibition* than the noncriminal group. In another study, Young et al. (2010) also revealed that 60 nonsexual offenders outperformed 60 sexual offenders in *cognitive flexibility*.

From the Asia-pacific region, a study conducted in Australia by Deuthser (2004) revealed that 25 sexual offenders, 25 nonsexual offenders, and 25 noncriminal group do not differ significantly in *cognitive flexibility, inhibition of impulse, and verbal fluency*. In a related study, Rodriguez (2014) compared 32 first-time adult sexual offenders aged 50 and above to 36 historical sexual offenders whose sexual crimes occurred before 50 years. The control group was 32 nonsexual offenders. It emerged that the sexual offenders in general performed significantly poorer than the nonsexual offenders in *attention, concentration, cognitive flexibility, response initiation and suppression, and verbal fluency*. However, the sexual offenders showed no significant group difference in these EF abilities.

In Europe, a study conducted by Fazel et al. (2007) in the United Kingdom revealed no significant difference in EF composite score (e.g. *verbal fluency, abstract thinking, alternating sequences, and cognitive estimates*) between 50 sexual offenders and 50 nonsexual criminal offenders.

Overall, there are inconsistencies in the results of the studies that have compared sexual offenders with a comparison group across different regions. Whereas some studies found that sexual offenders were significantly impaired than the comparison groups in some EF profiles (e.g. Rodriguez, 2014; Spinella et al., 2006; Stone & Thompson, 2001; Young et al., 2010), others failed to document any significant difference (Deuthser, 2004; Fazel et al., 2007; Gillespie & McKenzie, 2000). Moreover, it also appears that studies that have investigated *cognitive flexibility* found evidence that sexual offenders were significantly impaired in this executive ability than the comparison group (Rodriguez, 2014; Stone & Thompson, 2001; Young et al., 2010). This is also true for studies that have examined *inhibition of interference* (Rodriguez, 2014; Spinella et al., 2006; Stone & Thompson, 2001). In general, these observations are fairly consistent with the overall findings of studies of pedophiles and child molesters.

Executive function profiles of juvenile male sexual offenders

Miller's (1997) study in the United States found that juvenile 50 sexual offenders and the comparison group (i.e. nonsexual juvenile offenders) demonstrated no significant difference in performance in *cognitive flexibility*. Similar result was noted by Rimmer (1998) who studied 20 juvenile sexual offenders in the United States. A Canadian study by Morais et al. (2015) also reported no statistically

significant difference between 127 sexual offenders and 56 nonsexual offenders in EF profiles (e.g. *cognitive flexibility, verbal fluency, concept formation, and problem solving skills*). However, in this study, when the sexual offenders were classified into those who targeted children as victims, and those with peer-aged/older victims, and compared with nonsexual offenders, interesting results emerged. Notably, the juvenile sexual offenders with children as victims performed significantly better than the nonsexual offenders in *problem-solving, deductive reasoning, and cognitive flexibility*. Similarly, juvenile sexual offenders with peer-aged or older victims outperformed the nonsexual juvenile offenders in *ability to switch* between numbers and letters, as measured by the Trail Making Test part B. On the other hand, the two groups of sexual offenders do not differ significantly in EF profiles.

On the contrary, Veneziano et al.'s (2004) investigation in the United States showed that 60 juvenile sexual offenders were significantly impaired in *visual conceptual and visuomotor abilities* than the noncriminal juvenile comparison group. There was, however, no significant difference in their performance in *executive planning abilities*.

In the United Kingdom, Kelly et al. (2002) investigated executive function and attention deficits in 30 juvenile sexual offenders. In this study, the juvenile sexual offenders performed significantly poorer in *response speed, verbal fluency* than the noncriminal group. However, no statistically significant difference in performance between the groups was found in *motor organization, planning, and strategy formation*. In another study from Japan, Miyaguchi and Shirataki (2015) examined 55 juvenile sexual offenders in EF profiles, and compared their performances with 155 nonsexual juvenile offenders. The result showed that the sexual offenders exhibited significant impairment in *cognitive flexibility, ability to inhibit responses* and to *learn rules, and ability to spread and execute task in a given time period* than the comparison group.

In summary, first, consistent with previous observations, it is evident that the performance of juvenile sexual offenders in executive abilities has been inconsistently reported. While some studies (Kelly et al., 2002; Miyaguchi & Shirataki, 2015; Veneziano et al., 2004) found juvenile sexual offenders to significantly perform poorly than the comparison group, others reported no such evidence (i.e. Miller, 1997; Morais et al., 2015; Rimmer, 1998). Morais et al. (2015) even reported better performance in EF by juvenile sexual offenders who have targeted children and peer age/older victims, compared to noncriminal comparison group. Most importantly, the pattern and nature of EF deficits in juvenile sexual offenders are difficult to ascertain.

Discussion

This review basically aimed to ascertain the EF profiles in sexual offenders. A major finding is that deficits in *cognitive flexibility* as well as in *inhibition of*

interference or *response inhibition* are frequently reported in adult male sexual offenders (pedophiles/child molesters and uncategorized sexual offenders). Thus, deficits in both higher (e.g. *cognitive flexibility*) and lower (e.g. *inhibition*) executive abilities might account for the propensity to commit sexual offenses by juvenile and adult males. This observation partly validated the assertion that both higher and lower executive abilities might help in understanding the etiology of sexual offense behaviors (Joyal et al., 2007; Morais et al., 2015).

Cognitive flexibility makes it possible for individuals to shift behavior readily and appropriately in response to changing environmental demands (Lezak et al., 2012). Mental rigidity or lack of *cognitive flexibility* typically results in non-adaptive behavior and substantial challenges in regulating one's conduct. In the context of sexual offenses, *cognitive flexibility* deficit may increase the vulnerability, as well as preclude individuals from discovering and adopting socially appropriate ways to respond to their sexual needs. Impairment in *cognitive flexibility* may adversely affect how individuals navigate and interact with the social world to meet their sexual needs in socially acceptable ways. Among pedophiles, for instance, inability to think divergently (i.e. mental rigidity) may compromise the ability to shift attention from children and to explore and obtain sexual pleasure from consenting adults. With regard to *inhibition of interference*, it is asserted that criminal behavior, in this context, sexual deviant behaviors, could result from inability to inhibit pre-potent responses (Chen, Muggleton, Juan, Tzeng, & Hung, 2008). Taking pedophiles, for example, it is argued that first time or persistent engagement in sexual offenses could emanate from a conditioned response to prepubescent children. The sight of these suitable and vulnerable targets may signal some motivational values in the form of sexual arousal or sexual fantasies. Thus, individuals high in disinhibition, which refers to '..... lack of planfulness and foresight, impaired regulation of affect and urges, insistence on immediate gratification and deficient behavioral restraint' (Patrick, Fowles, & Krueger, 2009), are more likely to undertake sexual deviant behaviors.

Equally important is the argument that the effects of these EF deficits may interact to influence the propensity to engage in sexual offenses. Likewise, deficits in *verbal fluency*, coupled with inability to inhibit and postpone sexual desires (i.e. *inhibition of interference*), and lack of consideration of alternatives or consequences (e.g. taking steps to seek or obtain a consensual sex from adults-*cognitive flexibility*) could account for sexual offense behaviors. More realistically, EF deficits can interact with psychosocial risk factors (poor interpersonal relationship skills, and previous childhood sexual abuse) to influence the tendency to engage in sexual offenses. Regarding juvenile male sexual offenders, there is no distinct pattern of EF deficits, partly because the few studies that have investigated this offender population have also administered different EF tests.

The findings that not all sexual offenders reported significantly more deficits in EF abilities than non-criminal participants have presumably two implications. First, among some individuals, EF deficit is one of the numerous contributory

factors to the propensity to engage in sexual deviant behaviors, thereby necessitating investigations into the predisposition factors (e.g. brain injuries resulting from stroke and hypertension, as well as prenatal and perinatal risk factors) of these deficits. Secondly, among some individuals, engagement in sexual offense behaviors may not be as a result of impairment in EF deficits, but by other factors (e.g. psychosocial risk factors). In view of this, it is argued that Flor-Henry (1987) hypothesized impaired fronto-temporal lobe in sexual offending is overly simplistic to offer a comprehensive and contemporary understanding of the emergence of sexual offending behaviors. This is also true for Chan, Heide, and Beauregard (2011) integrated theory of sexual crimes which includes only psychosocial factors based on social learning and routine activity theories. Theoretical formulations that incorporate neurocognitive as well as psychosocial risk factors are more likely to offer a comprehensive view of sexual deviant behaviors. A notable theory in this regard is Ward and Beech (2006) integrated theory of sexual offending. This theory adopted a nuanced approach in which sexual deviant behaviors are conceptualized as emerging from a constellations of factors rooted in individuals' biological (including interlocking neuropsychological functions), psychosocial, and environmental risk factors (see Ward & Beech, 2006).

Treatment implications

Despite the proliferation of studies on EF in sexual offenders, the institutionalization of cognitive remediation programs has shockingly being slow to develop, even for non-sexual offenders (Rocha et al., 2014; Ross, 2012; Ross & Hoaken, 2010). This observation partly stem from the fact many researchers and clinicians with pervasive interests in EF in clinical and neurological patients have remained largely independent from those with interest in criminal offenders, leading to failures to apply empirically proven rehabilitations to criminal offenders. Collaboration between these two groups of researchers is one of plausible strategies and the way forward to rehabilitating offenders with neurocognitive deficits. While several EF deficits could be targeted, this review has shown that among adult male sexual offenders, focusing on impairment in *cognitive flexibility* and *inhibition of interference* may be useful. This being said, assessment and treatment of EF dysfunctions in sexual offenders should be done cautiously as the goal of treatment may not be achieved when the offenders are seen as a homogeneous group. Obviously, offenders convicted of the same crime (e.g. pedophilia or rape) do exhibit somewhat distinct EF profiles, thus, highlighting the need to assess each sexual offender uniquely to ascertain the nature and extent of EF deficits which can be the focus of intervention.

In this regard, the Risk–Need–Responsivity (R–N–R) treatment model espoused by Andrews, Bonta, and Hoge (1990) might be important and useful. At least, there is some evidence that EF deficit is a risk factor which predisposed

to involvement in sexual deviant behaviors (i.e. Risk principle). The specific EF abilities impaired in these offenders, and hence more likely to predict future offending, should be mitigated with appropriate intervention programs (i.e. Need principle). EF is posited as a dynamic risk factor, owing to its amenability to intervention. Illustrating, perhaps the first-ever neurocognitive deficit intervention study of female prison inmates by Rocha et al. (2014) reported positive changes in cognitive flexibility, planning, attention, processing speed, and verbal learning and memory. Furthermore, a decrease in psychological distress (e.g. depression, anxiety and stress) was reported as a collateral benefit of the cognitive remediation program. Generally, the treatability of EF deficits has largely been proved in clinical patients (see Cicerone et al., 2005, 2011).

In applying the Need principle, clinicians are admonished to assess and identify the pattern and nature of EF deficits in each sexual offender. For instance, pedophile 'A' may present with deficits in *cognitive flexibility* whereas pedophile 'B' may also show *dysfunction in inhibition of interference*. *Verbal learning* deficits in some sexual offenders partly suggest that verbal instructions to perform treatment tasks may not be well comprehended. Therefore, in addition to providing concrete instructions and tasks (e.g. role play), offenders with *verbal learning* deficits would have to be guided slowly through the treatment process. When necessary, assistance (e.g. helping in remembering the instructions) may be provided at the early stages and gradually removed as the offenders demonstrate mastery and proficiency over the learning process. Deficits in *verbal fluency* may similarly impede the extent to which the offenders would be able to verbalize or provide feedback on the task (e.g. whether the task was difficult, the strategies employed, and the ability to use the strategies in daily life).

Additionally, the severity of the deficits should be estimated as offenders with the same deficits may differ in terms of severity. In general, we do not endorse any straightforward approach in which, for example, all pedophiles are assumed to be characterized by particular EF deficits. Even if they do, the nature and severity of the deficits may differ, thereby ultimately informing the type as well as the intensity of interventions for each offender (i.e. different number of treatment sessions) as asserted by the Responsivity principle. Repeated assessments to monitor the progress of as well as to adapt treatment plans and goals to match offenders' changing EF deficits are warranted.

More generally, given the involvement of psychosocial factors in sexual deviant behaviors, focusing exclusively on rehabilitating only EF deficits would prove less useful in reducing the risk of future offending. This is particularly true in view of the evidence that some sexual offenders were not significantly impaired in EF, relative to the noncriminal comparison group. The best approach is, therefore, to construe sexual offenders as 'neuropsychosocial beings' and consequently to institute intervention programs targeting their neurocognitive, psychological aberrations (e.g. cognitive distortions), and social problems (e.g. unemployment). On the whole,

treatments targeting all salient neurocognitive, psychological and social factors implicated in sexual offending are envisaged to have the potential to reduce recidivism tendencies.

Issues associated with administering executive function tests in sexual offenders

Because EF is variously defined to consist of a complex set of processes, so are many measures purportedly assessing these processes. However, as shown in Tables 1–3, the most administered tests for both adult and juvenile male sexual offenders were the Wisconsin Card Sorting Test (WCST), Trail Making Test A and B (TMT A and B), Stroop Test, Controlled Oral Word Association Test (COWAT), California Verbal Learning Test (CVLT), and Tower of London. Unsurprisingly, these tests, specifically the WCST, TMT A and B, COWAT, and Stroop Test, are among the most (i.e. top 10) frequently administered EF tests revealed by a survey of 747 clinical neuropsychologists in the United States and Canada (Rabin, Barr, & Burton, 2005).

Generally, patients with frontal lobe lesions tend to perform poorly on some of these EF tests while at the same time exhibiting remarkably intact performance on other neuropsychological tests (e.g. measures of memory). However, there are concerns regarding the sensitivity of these tests to frontal lobe lesions (Lezak et al., 2012; Strauss, Sherman, & Spreen, 2006). This implies that test selection deserves a critical attention since some tests may be more sensitive and specific to EF deficits than others (see also Ogilvie et al., 2011). The Behavioral Assessment of Dysexecutive Syndrome and the Category Test are typical examples of tests with no demonstrable sensitivities to frontal lobe damage (Strauss et al., 2006). Other tests such as the WCST and Stroop Test appeared to be more sensitive to frontal lobe lesions (Alvarez & Emory, 2006; Joyal et al., 2007; Lezak et al., 2012; Strauss et al., 2006). The use of tests with varying sensitivities to EF deficits could partly explain the inconsistent findings discussed above. It is recommended that future studies administer tests with high sensitivities to frontal lobe lesions, and they should be selected based on their psychometric properties rather than on face validity (see Lezak et al., 2012; Strauss et al., 2006).

In addition to the above, although EF tests can detect changes in cognition in clinical and neurological patients with brain injuries, the appropriateness of utilizing these tests, which have been validated on clinical and neurological patients, on sexual offenders remains questionable or unknown. What is more worrying is that relatively little is known about whether sexual offenders and patients with TBI have similar or the same pattern of neurocognitive deficits to warrant the use of same tests on these populations. This may also contribute to the inconsistencies and the difficulties in delineating specific EF profiles in sexual offenders. A comparative study involving well-defined sexual offender group (e.g. pedophiles) and TBI patients, both with neuroimaging (e.g. magnetic

resonance imaging or functional magnetic resonance imaging) evidence of frontal lobe lesions, could be a starting point in determining the appropriateness of the existing EF tests on sexual offenders. Alternatively, because of the scientific and clinical appropriateness of using tests developed purposely for specific populations in a specific setting via a specific medium (Adjorlolo, 2015; Adjorlolo & Chan, 2015), construction of tests specifically on sexual offenders is highly recommended.

Moreover, many EF measures tap multiple aspects of EF. The WCST, for instance, assesses the following abilities: *cognitive flexibility*, *problem-solving*, and *response maintenance* (Greve et al., 2002). The Stroop Test, on the other hand, is used as a measure of *selective attention*, and *interference control* (MacLeod, 1991; Stuss & Levine, 2002). Because multiple EF processes may be invoked by a single complex task, and a single EF process may equally be elicited across multiple tasks (Anderson, 2002), it is inherently and extremely difficult to ascertain the specific EF deficits that are associated with performance on a single EF test. As a result, performances on these tests do not necessarily and specifically address fine-grained questions about the specific aspects of EF in relation to specific sexual offense. Complicating matters further is the observation that many EF tests involve complex, demanding and multifaceted tasks that mostly need both EF and non-EF abilities to accomplish (i.e. task impurity). For example, performance on the Stroop Test also involves color processing and articulation speed. Likewise, the spatial N-back task requires visuospatial processing (Miyake, Emerson, & Friedman, 2000). Verbal fluency task can also tap non-executive ability of semantic memory. As a consequence, all EF tasks include systematic variance attributable to non-EF processes associated with the specific task in question, making it difficult to ascertain the true and clean picture of EF variance of interest in sexual offenders.

These challenges can be reduced partly by selecting tasks designed to more specifically place demands on individual aspects of EF of interest. These tasks are somewhat different from the traditional EF tests. For example, the Color-Word Stroop (experimental version) can be used in place of the traditional Color-Word Stroop Test (neuropsychological version) to estimate *inhibition of interference*. Similarly, the Category Switch, Number-letter switch, and Color-shape switch can be used instead of the traditional WCST, TMTB, and Object Alternation Test or Delayed Alternation Test, respectively, as more specific EF measures of shifting or cognitive flexibility (see Friedman et al., 2008; Goschke, 2014; Miyake et al., 2000; Snyder et al., 2015). Specific EF abilities can also be well delineated when researchers or clinicians are able to control for the strategies the examinees are likely to employ to accomplish specific EF task (see Miyake et al., 2000). Another way to overcome the aforementioned problems, especially task impurity, is via the use of multiple measures of the same ability. Employing multiple tasks assessing the same ability in research and clinical practice lessens the idiosyncratic, nonexecutive task requirements, thereby providing information to

gauge individuals' performance (e.g. deficits) in the specific EF ability of interest (Miyake et al., 2000; Strauss et al., 2006).

As EF purportedly encompasses several abilities, with several tests supposedly assessing these abilities, the practice of summing or averaging test scores to obtain composite EF scores further obscure these abilities in sex offenses. Because not all EF components may be equally relevant in understanding the emergence of sexual offense behaviors, composite scores create a situation whereby it may not be immediately known which EF abilities should be given greater research attention and/or should be targeted in neurocognitive rehabilitation programs. In effect, by aggregating supposedly 'useful' and 'less useful' executive abilities, we risk obscuring the true influence of EF in sexual offenses. Even when sexual offenders appeared defective in EF composite score, compared with a comparison group (see Suchy et al., 2009), the usefulness of the composite score to explain differences in abilities and behaviors is elusive. On this basis, we recommend that future studies should explicate individual EF abilities in sexual offenders.

General limitations

Recently, studies are adopting well-designed methodologies to investigate EF deficits in sexual offenders (e.g. Eastvold et al., 2011; Suchy et al., 2009; Young et al., 2010). However, there are substantial challenges that not only account for the inconsistent results, but also limit our understanding of the possible influence of EF deficits in the commission of sexual offenses. One obvious limitation is the small sample size, as previously indicated. Additionally, some authors provided little or no information concerning the subtype of sexual offenders included in the studies (e.g. Fazel et al., 2007; Gillespie & McKenzie, 2000; Spinella et al., 2006). Even where such information is provided, the statistical analyses are not conducted based on the subtypes (e.g. Deuthser, 2004; Rodriguez, 2014; Young et al., 2010). Besides, it is impossible to ascertain whether the studies investigated violent, nonviolent, or both violent and nonviolent sexual offenders. Apart from contributing to the mixed findings, it remains largely unknown whether violent and nonviolent sexual offenders differ in their EF profiles. Furthermore, information concerning whether the participants were diagnosed with other psychiatric disorders was not provided (exception; Gillespie & McKenzie, 2000; Young et al., 2010). Because psychopathologies can predispose individuals to commit sexual crimes (Fazel, Sjöstedt, Långström, & Grann, 2007; Lord & Perkins, 2014), comparing those with and without psychiatric disorders can help reveal the true influence of EF profile in sexual offenders.

In conclusion, this review, for obvious reasons (i.e. small number of studies), did not meet the goals of contrasting male and female sexual offenders, as well as adults and juvenile sexual offenders on EF profiles. However, it has shown

that deficits in *cognitive flexibility* and *inhibition of interference* are commonly reported in adult male sexual offenders.

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No potential conflict of interest was reported by the authors.

References

- References marked with an asterisk indicate studies included in the systematic review.
- *Abracen, J., O'Carroll, R., & Ladha, N. (1991). Neuropsychological dysfunction in sex offenders? *The Journal of Forensic Psychiatry*, 2, 167–177. doi:10.1080/09585189108407646
- Adjorlolo, S. (2015). Can teleneuropsychology help meet the neuropsychological needs of Western Africans? The case of Ghana. *Applied Neuropsychology: Adult*, 22(5), 388–398. doi:10.1080/23279095.2014.949718
- Adjorlolo, S., & Chan, H. C. (2015). Forensic assessment via videoconferencing: Issues and practice considerations. *Journal of Forensic Psychology Practice*, 15, 185–204. doi:10.1080/15228932.2015.1015363
- Alvarez, J., & Emory, E. (2006). Executive function and the frontal lobes: A meta-analytic review. *Neuropsychology Review*, 16, 17–42. doi:10.1007/s11065-006-9002-x
- Anderson, P. (2002). Assessment and development of executive function during childhood. *Child Neuropsychology*, 8, 71–82. doi:10.1076/chin.8.2.71.8724
- Andrews, D. A., Bonta, J., & Hoge, R. D. (1990). Classification for effective rehabilitation: Rediscovering psychology. *Criminal Justice and Behavior*, 17, 19–52. doi:10.1177/0093854890017001004
- Bauman Johnson, W. L., Maricle, D. E., Miller, D. C., Allen, D. N., & Mayfield, J. (2010). Utilization of the comprehensive trail making test as a measure of executive functioning in children and adolescents with traumatic brain injuries. *Archives of Clinical Neuropsychology*, 25, 601–609. doi:10.1093/arclin/acq049
- *Becerra-García, J. A., & Egan, V. (2014). Neurocognitive functioning and subtypes of child molesters: Poorer working memory differentiates incestuous from non-incestuous offenders. *Psychiatry, Psychology and Law*, 21, 585–590. doi:10.1080/13218719.2013.873974
- Blanchard, R., Christensen, B. K., Strong, S. M., Cantor, J. M., Kuban, M. E., Klassen, P., & Blak, T. (2002). Retrospective self-reports of childhood accidents causing unconsciousness in phallometrically diagnosed pedophiles. *Archives of Sexual Behavior*, 31, 511–526.
- Blanchard, R., Kuban, M. E., Klassen, P., Dickey, R., Christensen, B. K., Cantor, J. M., & Blak, T. (2003). Self-reported head injuries before and after age 13 in pedophilic and nonpedophilic men referred for clinical assessment. *Archives of Sexual Behavior*, 32, 573–581.
- Bruns, J. & Hauser, W. A. (2003). The epidemiology of traumatic brain injury: A review. *Epilepsia*, 44(10), 2–10.
- Chan, H. C. O., & Beaugard, E. (2015). Non-homicidal and homicidal sexual offenders: Prevalence of maladaptive personality traits and paraphilic behaviors. *Journal of Interpersonal Violence*. (advanced online publishing). doi:10.1177/0886260515575606
- Chan, H. C. O., & Heide, K. M. (2009). Sexual homicide: A synthesis of the literature. *Trauma, Violence, & Abuse*, 10, 31–54. doi:10.1177/1524838008326478
- Chan, H. C. O., Heide, K. M., & Beaugard, E. (2011). What propels sexual murderers: A proposed integrated theory of social learning and routine activities theories.

- International Journal of Offender Therapy and Comparative Criminology*, 55, 228–250. doi:[10.1177/0306624x10361317](https://doi.org/10.1177/0306624x10361317)
- Chen, C.-Y., Muggleton, N. G., Juan, C.-H., Tzeng, O. J. L., & Hung, D. L. (2008). Time pressure leads to inhibitory control deficits in impulsive violent offenders. *Behavioural Brain Research*, 187, 483–488. doi:[10.1016/j.bbr.2007.10.011](https://doi.org/10.1016/j.bbr.2007.10.011)
- Cicerone, K. D., Dahlberg, C., Malec, J. F., Langenbahn, D. M., Felicetti, T., Kneipp, S., ... Harley, J. P. (2005). Evidence-based cognitive rehabilitation: Updated review of the literature from 1998 through 2002. *Archives of Physical Medicine and Rehabilitation*, 86, 1681–1692.
- Cicerone, K. D., Langenbahn, D. M., Braden, C., Malec, J. F., Kalmar, K., Fraas, M., ... Bergquist, T. (2011). Evidence-based cognitive rehabilitation: Updated review of the literature from 2003 through 2008. *Archives of Physical Medicine and Rehabilitation*, 92, 519–530.
- *Cohen, L. J., Nesci, C., Steinfeld, M., Haeri, S., & Galynker, I. (2010). Investigating the relationship between sexual and chemical addictions by comparing executive function in pedophiles, opiate addicts and healthy controls. *Journal of psychiatric practice*, 16, 405–412. doi:[10.1097/01.pra.0000390759.04581.7c](https://doi.org/10.1097/01.pra.0000390759.04581.7c)
- *Cohen, L., Nikiforov, K., Gans, S., Poznansky, O., McGeoch, P., Weaver, C., ... Galynker, I. (2002). Heterosexual male perpetrators of childhood sexual abuse: A preliminary neuropsychiatric model. *Psychiatric Quarterly*, 73, 313–336. doi:[10.1023/A:1020416101092](https://doi.org/10.1023/A:1020416101092)
- Corrigan, J. D., Selassie, A. W., & Orman, J. A. L. (2010). The epidemiology of traumatic brain injury. *The Journal of Head Trauma Rehabilitation*, 25, 72–80.
- *Deuthser, M. (2004). *A neuropsychological assessment of adult sex offenders* (Unpublished doctoral dissertation). Swinburne University of Technology. Melbourne, Victoria.
- *Eastvold, A., Suchy, Y., & Strassberg, D. (2011). Executive function profiles of pedophilic and nonpedophilic child molesters. *Journal of the International Neuropsychological Society*, 17, 295–307.
- Farrer, T. J., Frost, R. B., & Hedges, D. W. (2013). Prevalence of traumatic brain injury in juvenile offenders: A meta-analysis. *Child Neuropsychology*, 19, 225–234. doi:[10.1080/09297049.2011.647901](https://doi.org/10.1080/09297049.2011.647901)
- Farrer, T. J., & Hedges, D. W. (2011). Prevalence of traumatic brain injury in incarcerated groups compared to the general population: A meta-analysis. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, 35, 390–394. doi:[10.1016/j.pnpbp.2011.01.007](https://doi.org/10.1016/j.pnpbp.2011.01.007)
- *Fazel, S., O'Donnell, I., Hope, T., Gulati, G., & Jacoby, R. (2007). Frontal lobes and older sex offenders: A preliminary investigation. *International Journal of Geriatric Psychiatry*, 22, 87–89. doi:[10.1002/gps.1648](https://doi.org/10.1002/gps.1648)
- Fazel, S., Sjöstedt, G., Långström, N., & Grann, M. (2007). Severe mental illness and risk of sexual offending in men: A case-control study based on Swedish national registers. *The Journal of Clinical Psychiatry*, 68, 588–596.
- Fishbein, D., Sheppard, M., Hyde, C., Hubal, R., Newlin, D., Serin, R., ... Alesci, S. (2009). Deficits in behavioral inhibition predict treatment engagement in prison inmates. *Law and Human Behavior*, 33, 419–435. doi:[10.1007/s10979-008-9163-7](https://doi.org/10.1007/s10979-008-9163-7)
- Flor-Henry, P. (1987). Cerebral aspects of sexual deviation. In G. D. Wilson (Ed.), *Variant sexuality: Research and theory* (pp. 49–83). London: Croom Helm.
- Friedman, N. P., Miyake, A., Young, S. E., DeFries, J. C., Corley, R. P., & Hewitt, J. K. (2008). Individual differences in executive functions are almost entirely genetic in origin. *Journal of Experimental Psychology: General*, 137, 201–225. doi:[10.1037/0096-3445.137.2.201](https://doi.org/10.1037/0096-3445.137.2.201)

- *Gillespie, N. K., & McKenzie, K. (2000). An examination of the role of neuropsychological deficits in mentally disordered sex offenders. *Journal of Sexual Aggression, 5*, 21–29. doi:10.1080/13552600008413293
- Goschke, T. (2014). Dysfunctions of decision-making and cognitive control as transdiagnostic mechanisms of mental disorders: Advances, gaps, and needs in current research. *International Journal of Methods in Psychiatric Research, 23*(S1), 41–57. doi:10.1002/mpr.1410
- Greve, K. W., Love, J. M., Sherwin, E., Mathias, C. W., Ramzinski, P., & Levy, J. (2002). Wisconsin card sorting test in chronic severe traumatic brain injury: Factor structure and performance subgroups. *Brain Injury, 16*, 29–40. doi:10.1080/0269905011008803
- Hargrave, D. D., Nupp, J. M., & Erickson, R. J. (2012). Two brief measures of executive function in the prediction of driving ability after acquired brain injury. *Neuropsychological Rehabilitation, 22*, 489–500. doi:10.1080/09602011.2012.662333
- *Joyal, C. C., Black, D. N., & Dassylva, B. (2007). The neuropsychology and neurology of sexual deviance: A review and pilot study. *Sexual Abuse: A Journal of Research and Treatment, 19*, 155–173. doi:10.1007/s11194-007-9045-4
- Joyal, C. C., Plante-Beaulieu, J., & de Chanterac, A. (2014). The neuropsychology of sexual offenders: A meta-analysis. *Sexual Abuse: A Journal of Research and Treatment, 26*, 147–177. doi:10.1177/1079063213482842
- Jurado, M., & Rosselli, M. (2007). The elusive nature of executive functions: A review of our current understanding. *Neuropsychology Review, 17*, 213–233. doi:10.1007/s11065-007-9040-z
- *Kelly, T., Richardson, G., Hunter, R., & Knapp, M. (2002). Attention and executive function deficits in adolescent sex offenders. *Child Neuropsychology, 8*, 138–143. doi:10.1076/chin.8.2.138.8722
- *Kruger, T. H. C., & Schiffer, B. (2011). Neurocognitive and personality factors in homo- and heterosexual pedophiles and controls. *The Journal of Sexual Medicine, 8*, 1650–1659. doi:10.1111/j.1743-6109.2009.01564.x
- Levenson, J. S., Willis, G. M., & Prescott, D. S. (2015). Adverse childhood experiences in the lives of female sex offenders. *Sexual Abuse: A Journal of Research and Treatment, 27*, 258–283. doi:10.1177/1079063214544332
- Lezak, M. D., Howieson, D. B., Bigler, E. D., & Tranel, D. (2012). *Neuropsychological assessment* (5th ed.). Oxford: Oxford University Press.
- Lord, A., & Perkins, D. (2014). Assessing and treating sexual offenders with mental disorders. *The Journal of Forensic Practice, 16*, 94–109. doi:10.1108/JFP-02-2013-0012
- MacLeod, C. M. (1991). Half a century of research on the Stroop effect: An integrative review. *Psychological Bulletin, 109*, 163–203. doi:10.1037/0033-2909.109.2.163
- Maes, J. H. R., Eling, P. A. T. M., Reelick, M. F., & Kessels, R. P. C. (2011). Assessing executive functioning: On the validity, reliability, and sensitivity of a click/point random number generation task in healthy adults and patients with cognitive decline. *Journal of Clinical and Experimental Neuropsychology, 33*, 366–378. doi:10.1080/13803395.2010.524149
- *Martin, J. E. (1998). *Assessment of executive functions in sexual offenders* (Unpublished doctoral dissertation). Adler School of Professional Psychology, Chicago, IL.
- McLeod, D. A. (2015). Female offenders in child sexual abuse cases: A national picture. *Journal of Child Sexual Abuse, 24*, 97–114. doi:10.1080/10538712.2015.978925
- *Miller, A. D. (1997). *Executive function deficits in incarcerated adolescent sexual offenders as measured by the Wisconsin Card Sorting Test (WCST)* (Unpublished doctoral dissertation). Adler School of Professional Psychology, Chicago, IL.
- *Miyaguchi, K., & Shirataki, S. (2015). Executive functioning problems of juvenile sex offenders with low levels of measured intelligence. *Journal of Intellectual and Developmental Disability, 39*, 253–260. doi:10.3109/13668250.2014.925103

- Miyake, A., Emerson, M. J., & Friedman, N. P. (2000). Assessment of executive functions in clinical settings: Problems and recommendations. *Paper Presented at the Seminars in Speech and Language, 21*, 169–183.
- Miyake, A., & Friedman, N. P. (2012). The nature and organization of individual differences in executive functions four general conclusions. *Current Directions in Psychological Science, 21*, 8–14. doi:10.1177/0963721411429458
- *Morais, H. B., Joyal, C. C., Alexander, A. A., Fix, R. L., & Burkhart, B. R. (2015). The neuropsychology of adolescent sexual offending testing an executive dysfunction hypothesis. *Sexual Abuse: A Journal of Research and Treatment* (advanced online publishing). doi:10.1177/1079063215569545
- Morgan, A. B., & Lilienfeld, S. O. (2000). A meta-analytic review of the relation between antisocial behavior and neuropsychological measures of executive function. *Clinical Psychology Review, 20*, 113–136. doi:10.1016/S0272-7358(98)00096-8
- Nee, D., Wager, T., & Jonides, J. (2007). Interference resolution: Insights from a meta-analysis of neuroimaging tasks. *Cognitive, Affective, & Behavioral Neuroscience, 7*, 1–17. doi:10.3758/CABN.7.1.1
- Ogilvie, J. M., Stewart, A. L., Chan, R. C. K., & Shum, D. H. K. (2011). Neuropsychological measures of executive function and antisocial behavior: A meta-analysis. *Criminology, 49*, 1063–1107. doi:10.1111/j.1745-9125.2011.00252.x
- Patrick, C. J., Fowles, D. C., & Krueger, R. F. (2009). Triarchic conceptualization of psychopathy: Developmental origins of disinhibition, boldness, and meanness. *Development and Psychopathology, 21*, 913–938. doi:10.1017/S0954579409000492
- Pflugradt, D. M., & Allen, B. P. (2010). An exploratory analysis of executive functioning for female sexual offenders: A comparison of characteristics across offense typologies. *Journal of Child Sexual Abuse, 19*, 434–449. doi:10.1080/10538712.2010.495701
- Rabin, L. A., Barr, W. B., & Burton, L. A. (2005). Assessment practices of clinical neuropsychologists in the United States and Canada: A survey of INS, NAN, and APA division 40 members. *Archives of Clinical Neuropsychology, 20*, 33–65. doi:10.1016/j.acn.2004.02.005
- *Rimmer L. M. (1998). *Executive functioning and problem-solving ability in youthful offenders: A neuropsychological assessment* (Unpublished doctoral dissertation). California School of Professional Psychology, Los Angeles, CA.
- Roch, N. B. F., Marques, A. B., Fortuna, R. B., Antunes, A., & Hoaken, P. N. S. (2014). Effectiveness of cognitive remediation for female inmates: A pilot study. *The Journal of Forensic Psychiatry & Psychology, 25*, 224–237. doi:10.1080/14789949.2014.884617
- *Rodriguez, M. (2014). *A neuropsychological study of first-time sex offenders over the age of 50: The possible contribution of cognitive deficits to sexual offending* (Unpublished Doctoral thesis). University of Sydney, Australia.
- Roozenbeek, B., Maas, A. I. R., & Menon, D. K. (2013). Changing patterns in the epidemiology of traumatic brain injury. *Nature Reviews Neurology, 9*, 231–236. doi:10.1038/nrneurol.2013.22
- Ross, E. (2012). *Are offence-focused correctional rehabilitation programs affecting inmates' executive cognitive functions?* (Unpublished doctoral dissertation). University of Western Ontario, Ontario.
- Ross, E. H., & Hoaken, P. N. (2010). Correctional remediation meets neuropsychological rehabilitation: How brain injury and schizophrenia research can improve offender programming. *Criminal Justice and Behavior, 37*, 656–677. doi:10.1177/0093854810363104
- *Schiffer, B., Peschel, T., Paul, T., Gizewski, E., Forsting, M., Leygraf, N., ... Krueger, T. H. (2007). Structural brain abnormalities in the frontostriatal system and cerebellum in pedophilia. *Journal of Psychiatric Research, 41*, 753–762. doi:10.1016/j.jpsychires.2006.06.003
- Schiffer, B., & Vonlaufen, C. (2011). Executive dysfunctions in pedophilic and nonpedophilic child molesters. *The Journal of Sexual Medicine, 8*(7), 1975–1984.

- Shiroma, E. J., Ferguson, P. L., & Pickelsimer, E. E. (2010). Prevalence of traumatic brain injury in an offender population: A meta-analysis. *Journal of Correctional Health Care, 16*, 147–159. doi:10.1177/1078345809356538
- Sigre-Leirós, V., Carvalho, J., & Nobre, P. (2015). Cognitive schemas and sexual offending: Differences between rapists, pedophilic and nonpedophilic child molesters, and nonsexual offenders. *Child Abuse & Neglect, 40*, 81–92. doi:10.1016/j.chiabu.2014.10.003
- Simpson, G., Blaszczyński, A., & Hodgkinson, A. (1999). Sex offending as a psychosocial sequela of traumatic brain injury. *The Journal of Head Trauma Rehabilitation, 14*, 567–580.
- Snyder, H. R., Miyake, A., & Hankin, B. L. (2015). Advancing understanding of executive function impairments and psychopathology: Bridging the gap between clinical and cognitive approaches. *Frontiers in Psychology, 6*, 1–24. doi:10.3389/fpsyg.2015.00328.
- *Spinella, M., White, J., Frank, M., & Schiraldi, J. (2006). Evidence of orbitofrontal dysfunction in sex offenders. *International Journal of Forensic Psychology, 1*, 62–68.
- *Stone, M. H., & Thompson, E. H. (2001). Executive function impairment in sexual offenders. *The Journal of Individual Psychology, 57*, 51–59.
- Strauss, E., Sherman, E. M. S., & Spreen, O. (2006). *A compendium of neuropsychological tests: Administration, norms and commentary* (3rd ed.). Oxford: Oxford University Press.
- Stuss, D. T. (2011). Traumatic brain injury: Relation to executive dysfunction and the frontal lobes. *Current Opinion in Neurology, 24*, 584–589. doi:10.1097/WCO.0b013e32834c7eb9
- Stuss, D. T., & Levine, B. (2002). Adult clinical neuropsychology: Lessons from studies of the frontal lobes. *Annual Review of Psychology, 53*, 401–433. doi:10.1146/annurev.psych.53.100901.135220
- *Suchy, Y., Whittaker, J. W., Strassberg, D. S., & Eastvold, A. (2009). Neurocognitive differences between pedophilic and nonpedophilic child molesters. *Journal of the International Neuropsychological Society, 15*, 248–257. doi:10.1017/S1355617709090353
- *Veneziano, C., Veneziano, L., LeGrand, S., & Richards, L. (2004). Neuropsychological executive functions of adolescent sex offenders and nonsex offenders 1, 2. *Perceptual and Motor Skills, 98*, 661–674. doi:10.2466/pms.98.2.661-674
- Ward, T., & Beech, A. (2006). An integrated theory of sexual offending. *Aggression and Violent Behavior, 11*, 44–63. doi:10.1016/j.avb.2005.05.002
- Ylvisaker, M., & DeBonis, D. (2000). Executive function impairment in adolescence: TBI and ADHD. *Topics in Language Disorders, 20*, 29–57. doi:10.1097/00011363-200020020-00005
- *Young, M. H., Justice, J. V., & Edberg, P. (2010). Sexual offenders in prison psychiatric treatment: A biopsychosocial description. *International Journal of Offender Therapy and Comparative Criminology, 54*, 92–112. doi:10.1177/0306624x08322373
- *Young, M. H., Justice, J., & Erdberg, P. (2012). A comparison of rape and molest offenders in prison psychiatric treatment. *International Journal of Offender Therapy and Comparative Criminology, 56*, 1103–1123. doi:10.1177/0306624x11417361

Appendix 1. Database, search strategy, and the number of hits (in bracket)

<i>ProQuest (438)</i>	<i>Criminal Justice Abstract (205)</i>
(neuropsychology*) and (sex* offend*)(77)	(neuropsychology*) and (sex* offend*)(60)
(neuropsychology*) and (pedophile*)(30)	(neuropsychology*) and (pedophile*)(25)
(neuropsychology*) and (sexual deviance)(10)	(neuropsychology*) and (sexual deviance)(6)
(neuropsychology*) and (rape or rapist)(27)	(neuropsychology*) and (rape or rapist)(9)
(neuropsychology*) and (paraphilia)(6)	(neuropsychology*) and (paraphilia)(9)
(neuropsychology*) and (adult sex* offend*)(34)	(neuropsychology*) and (adult sex* offend*)(7)
(neuropsychology*) and (juvenile sex* offend*)(35)	(neuropsychology*) and (juvenile sex* offend*)(3)
(neuropsychology*) and (adolescent sex* offend*)(23)	(neuropsychology*) and (adolescent sex* offend*)(5)

(Continued).

Appendix 1. (Continued).

(neuropsychology*) and (youth sex* offend*)(12)	(neuropsychology*) and (youth sex* offend*)(0)
(neurocognitive function*) and (sex* offend*)(7)	(neurocognitive function*) and (sex* offend*)(4)
(neurocognitive function*) and (pedophil*)(8)	(neurocognitive function*) and pedophil* (2)
(neurocognitive function*) and (sexual deviance)	(neurocognitive function*) and (sexual deviance)
(1)	(1)
(neurocognitive function*) and (rape or rapist)(1)	(neurocognitive function*) and (rape or rapist)(1)
(neurocognitive function*) and (paraphilia)(0)	(neurocognitive function*) and (paraphilia)(1)
(neurocognitive function*) and (adult sex* offend*)(5)	(neurocognitive function*) and (adult sex* offend*)(1)
(neurocognitive function*) and (juvenile sex* offend*)(1)	(neurocognitive function*) and (juvenile sex* offend*)(1)
(neurocognitive function*) and (adolescent sex* offend*)(1)	(neurocognitive function*) and (adolescent sex* offend*)(0)
(neurocognitive function*) and (youth sex* offend*)(0)	(neurocognitive function*) and (youth sex* offend*)(0)
(executive function*) and (sex* offend*)(36)	(executive function*) and (sex* offend*)(18)
(executive function*) and (pedophil*) (10)	(executive function*) and pedophil*(6)
(executive function*) and (sexual deviance)(2)	(executive function*) and (sexual deviance)(2)
(executive function*) and (rape or rapist)(8)	(executive function*) and (rape or rapist)(5)
(executive function*) and paraphilia(1)	(executive function*) and paraphilia(2)
(executive function*) and (adult sex* offend*)(13)	(executive function*) and (adult sex* offend*)(2)
(executive function*) and (juvenile sex* offend*)	(executive function*) and (juvenile sex* offend*)
(16)	(1)
(executive function*) and (adolescent sex* offend*)(10)	(executive function*) and (adolescent sex* offend*)(4)
(executive function*) and (youth sex* offend*)(6)	(executive function*) and (youth sex* offend*)(0)
(frontal lobe) and (sex* offend*)(15)	(frontal lobe) and (sex* offend*)(7)
(frontal lobe) and (pedophil*) (7)	(frontal lobe) and (pedophil*)(4)
(frontal lobe) and (sexual deviance)(2)	(frontal lobe) and (sexual deviance)(1)
(frontal lobe) and (rape or rapist)(2)	(frontal lobe) and (rape or rapist)(2)
(frontal lobe) and (paraphilia) (4)	(frontal lobe) and (paraphilia)(1)
(frontal lobe) and (adult sex* offend*)(1)	(frontal lobe) and (adult sex* offend*)(0)
(frontal lobe) and (juvenile sex* offend*)(6)	(frontal lobe) and (juvenile sex* offend*)(0)
(frontal lobe) and (adolescent sex* offend*)(2)	(frontal lobe) and (adolescent sex* offend*)(0)
(frontal lobe) and (youth sex* offend*)(1)	(frontal lobe) and (youth sex* offend*)(0)
(prefrontal cortex) and (sex* offend*)(4)	(prefrontal cortex) and (sex* offend*)(3)
(prefrontal cortex) and (pedophil*)(8)	(prefrontal cortex) and (pedophil*)(5)
(prefrontal cortex) and (sexual deviance)(0)	(prefrontal cortex) and (sexual deviance)(0)
(prefrontal cortex) and (rape or rapist)(3)	(prefrontal cortex) and (rape or rapist)(4)
(prefrontal cortex) and (paraphilia)(2)	(prefrontal cortex) and (paraphilia)(1)
(prefrontal cortex) and (adult sex* offend*)(1)	(prefrontal cortex) and (adult sex* offend*)(1)
(prefrontal cortex) and (juvenile sex* offend*)(1)	(prefrontal cortex) and (juvenile sex* offend*)(1)
(prefrontal cortex) and (adolescent sex* offend*)	(prefrontal cortex) and (adolescent sex* offend*)
(0)	(0)
(prefrontal cortex) and (youth sex* offend*)(0)	(prefrontal cortex) and (youth sex* offend*)(0)
<i>EBSCOhost (362)</i>	<i>Social Sciences Citation Index (293)</i>
(neuropsychology*) and (sex* offend*)(99)	(neuropsychology*) and (sex* offend*)(44)
(neuropsychology*) and (pedophile*)(56)	(neuropsychology*) and (pedophile*)(20)
(neuropsychology*) and (sexual deviance)(8)	(neuropsychology*) and (sexual deviance)(7)
(neuropsychology*) and (rape or rapist)(26)	(neuropsychology*) and (rape or rapist)(11)
(neuropsychology*) and (paraphilia)(12)	(neuropsychology*) and (paraphilia)(2)
(neuropsychology*) and (adult sex* offend*)(8)	(neuropsychology*) and (adult sex* offend*)(18)
(neuropsychology*) and (juvenile sex* offend*)(6)	(neuropsychology*) and (juvenile sex* offend*)(8)
(neuropsychology*) and (adolescent sex* offend*)	(neuropsychology*) and (adolescent sex* offend*)
(8)	(6)
(neuropsychology*) and (youth sex* offend*)(0)	(neuropsychology*) and (youth sex* offend*)(0)
(neurocognitive function*) and (sex* offend*)(5)	(neurocognitive function*) and (sex* offend*)(10)
(neurocognitive function*) and (pedophil*)(3)	(neurocognitive function*) and (pedophil*) (7)
(neurocognitive function*) and (sexual deviance)	(neurocognitive function*) and (sexual deviance)
(1)	(1)

Appendix 1. (Continued).

(neurocognitive function*) and (rape or rapist)(1)	(neurocognitive function*) and (rape or rapist)(0)
(neurocognitive function*) and (paraphilia)(1)	(neurocognitive function*) and (paraphilia)(0)
(neurocognitive function*) and (adult sex* offend*)(1)	(neurocognitive function*) and (adult sex* offend*)(3)
(neurocognitive function*) and (juvenile sex* offend*)(1)	(neurocognitive function*) and (juvenile sex* offend*)(1)
(neurocognitive function*) and (adolescent sex* offend*)(0)	(neurocognitive function*) and (adolescent sex* offend*)(2)
(neurocognitive function*) and (youth sex* offend*)(0)	(neurocognitive function*) and (youth sex* offend*)(0)
(executive function*) and (sex* offend*)(40)	(executive function*) and (sex* offend*)(27)
(executive function*) and pedophil*(10)	(executive function*) and (pedophil*)(9)
(executive function*) and (sexual deviance) (3)	(executive function*) and (sexual deviance)(2)
(executive function*) and (rape or rapist)(7)	(executive function*) and (rape or rapist)(4)
(executive function*) and (paraphilia)(3)	(executive function*) and (paraphilia)(1)
(executive function*) and (adult sex* offend*)(2)	(executive function*) and (adult sex* offend*)(11)
(executive function*) and (juvenile sex* offend*)(2)	(executive function*) and (juvenile sex* offend*)(3)
(executive function*) and (adolescent sex* offend*)(6)	(executive function*) and (adolescent sex* offend*)(6)
(executive function*) and (youth sex* offend*)(0)	(executive function*) and (youth sex* offend*)(2)
(frontal lobe) and (sex* offend*)(15)	(frontal lobe) and (sex* offend*)(14)
(frontal lobe) and (pedophil*)(7)	(frontal lobe) and (pedophil*)(4)
(frontal lobe) and (sexual deviance)(2)	(frontal lobe) and (sexual deviance)(2)
(frontal lobe) and (rape or rapist)(4)	(frontal lobe) and (rape or rapist)(2)
(frontal lobe) and (paraphilia)(3)	(frontal lobe) and (paraphilia)(1)
(frontal lobe) and (adult sex* offend*)(0)	(frontal lobe) and (adult sex* offend*)(4)
(frontal lobe) and (juvenile sex* offend*)(0)	(frontal lobe) and (juvenile sex* offend*)(3)
(frontal lobe) and (adolescent sex* offend*)(1)	(frontal lobe) and (adolescent sex* offend*)(3)
(frontal lobe) and (youth sex* offend*)(0)	(frontal lobe) and (youth sex* offend*)(1)
(prefrontal cortex) and (sex* offend*)(4)	(prefrontal cortex) and (sex* offend*)(20)
(prefrontal cortex) and (pedophil*)(9)	(prefrontal cortex) and (pedophil*)(10)
(prefrontal cortex) and (sexual deviance)(0)	(prefrontal cortex) and (sexual deviance)(1)
(prefrontal cortex) and (rape or rapist)(4)	(prefrontal cortex) and (rape or rapist)(9)
(prefrontal cortex) and (paraphilia)(2)	(prefrontal cortex) and (paraphilia)(2)
(prefrontal cortex) and (adult sex* offend*)(1)	(prefrontal cortex) and (adult sex* offend*)(3)
(prefrontal cortex) and (juvenile sex* offend*)(1)	(prefrontal cortex) and (juvenile sex* offend*)(1)
(prefrontal cortex) and (adolescent sex* offend*)(0)	(prefrontal cortex) and (adolescent sex* offend*)(3)
(prefrontal cortex) and (youth sex* offend*)(0)	(prefrontal cortex) and (youth sex* offend*)(2)