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Rapists and Child Abusers Share Low Levels in Executive Updating, but Do not in Fluid Reasoning

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ABSTRACT

Research findings suggest that sex offenders show worse performance than the general population in neuropsychological tests. Nevertheless, moderators such as age of the victim, use of antisocial control groups, and characteristics of administered measures have been highlighted. Here, 100 participants completed a battery of cognitive measures tapping fluid reasoning, verbal ability, and three basic executive processes (inhibition, switching, and updating). They were matched by educational level and classified in four groups: controls, non-sex offenders, rapists, and child abusers. The analyses revealed that rapists showed lower fluid reasoning scores than controls and child abusers. Furthermore, rapists and child abusers showed lower executive updating performance than controls and non-sex offenders. Importantly, child abusers did show fluid reasoning scores on a par with controls (controlling for updating differences), but their executive updating performance was equivalent to the one revealed by rapists (controlling for fluid intelligence differences). Implications of these findings for the design of efficient intervention programs are discussed.

Los violadores y los que abusan de niños comparten un bajo nivel de actualización ejecutiva pero no de razonamiento fluido

Palabras clave:
Agresores sexuales
Inteligencia
Función ejecutiva

RESUMEN

Los datos de investigación empírica sugieren que los delincuentes sexuales presentan un peor desempeño que la población general en las pruebas neuropsicológicas. Aun así, se ha resaltado la influencia de variables moderadoras como la edad de la víctima, el uso de grupos control que incluyan individuos antisociales y las características de las medidas utilizadas. En este estudio cien participantes completaron una batería de pruebas cognitivas que evalúan razonamiento fluido, capacidad verbal y tres funciones ejecutivas básicas (inhibición, cambio y actualización). Los participantes estaban igualados en su nivel educativo y divididos en cuatro grupos: controles, delincuentes no sexuales, agresores sexuales con víctimas adultas y abusadores de menores. Los análisis revelaron que los agresores sexuales con víctimas adultas presentaban puntuaciones menores que los controles y los abusadores de menores en razonamiento fluido. Más aún, los agresores con víctimas adultas y los abusadores tenían peor desempeño que los controles y los delincuentes no sexuales en actualización ejecutiva. Es destacable que los abusadores de menores mostraran puntuaciones en razonamiento fluido equiparables a las de los controles (controlando estadísticamente las diferencias en actualización), pero su desempeño en actualización ejecutiva fue equivalente al mostrado por los agresores con víctimas adultas (controlando estadísticamente las diferencias en inteligencia fluida). Finalmente se discuten las implicaciones de estos resultados para el diseño de programas de intervención efectivos.

Inhibition, switching, updating, and planning involve cognitive processes summarized by the "executive" label (Elderkin-Thompson, Ballmaier, Hellemann, Pham, & Kumar, 2008; Fournier-Vicente et al., 2008; Friedman et al., 2006; Friedman et al., 2008; Garon, Bryson, & Smith, 2008; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). Executive cognitive processes require control and regulation (Colom, Abad, Quiroga, Shih, & Flores-Mendoza, 2008; Engle & Kane, 2004; Martínez et al., 2011; van der Sluis, de Jong, & van Der Leij, 2007) and facilitate coping with situations in a flexible way, creating and adapting plans of thought and action.

Executive impairments might have negative impact on everyday life behaviors (Romer et al., 2009; van Goozen, Fairchild, Snoek, &

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Harold, 2007), including antisocial behavior (Dolan & Anderson, 2002; Hoaken, Allaby, & Earle, 2007; Mullin & Simpson, 2007; Paschall & Fishbein, 2002; Sadeh & Verona, 2008; Séguin, 2004; Stanford, Conklin, Helfritz, & Kockler, 2007; Stevens, Kaplan, & Hesselbrock, 2003). In this regard, Morgan and Lilienfeld (2000) reviewed a large set of neuropsychological measures of executive function, reporting an average difference greater than half a standard deviation (d = 0.62) between controls and antisocial individuals. Likewise, Ogilvie, Stewart, Chan, and Shum (2011) conducted a meta-analysis on the same topic, which was actually an extension of the former work by Morgan and Lilienfeld, finding an medium overall effect size (d = 0.42). Nevertheless, straightforward assessments of executive processes are unusual, as highlighted by Chan, Shum, Toulopoulou, and Chen (2008). Standardized evaluations of executive function accessible to clinicians and neuropsychologists are not specific enough for obtaining clear-cut theory-based conclusions (Shallice, 1988; Stuss et al., 2005).

Several studies have explored the differences in executive function tests between sexual offenders and control groups. For example, Eastvold, Suchy, and Strassberg (2011) compared two samples of pedophilic and non-pedophilic child molesters (n = 30 in each sample) classified according to their phallometric responses, with 29 non-sexual offenders. Participants completed tests evaluating several executive processes (switching, inhibition, abstraction, working memory, fluency, planning, and simple attention). Results failed to reveal differences between sexual and non-sexual offenders when executive function was defined as a unitary construct through a statistically derived composite score. When different profiles were examined, results indicated that child molesters performed better than controls on abstract reasoning but worse on inhibition.

Young, Justice, and Erdberg (2012) compared two samples of molest (n = 15) and rape (n = 45) offenders, using the Wisconsin Card Sorting Test (WCST) and the Trail Making Test (TMT). Rape offenders performed worse than molest offenders in several processes, but no differences were found when executive function was considered.

Schiffer and Vonlaufen (2011) compared 15 pedophilic and 15 non-pedophilic child molesters with 16 nonsexual offenders and 17 community controls. All samples completed a computerized version of the Tower of London, a Go/No-Go task, the WCST, and the TMT. Pedophiles performed more poorly on inhibition than the community non-sexual offender groups, while non-pedophiles performed worse on cognitive flexibility.

In general, studies concerned with executive performance in sexual offenders have found that offenders' subgroups tend to display a distinctive cognitive profile, and overall differences in executive function are not found (see Adjorlo & Egbenya, 2016, for a comprehensive review of the topic). Recently, Joyal, Beaulieu-Plante, and de Chantérac (2014) conducted a meta-analysis on the topic of the neuropsychological profile of sex offenders, underscoring the relevance of several moderator variables, in particular the age of the victim, the nature of the comparison group, and the type of neuropsychological measure.

Regarding the age of the victim, offenders who assault prepubescent children seem to display a more intense pattern of neuropsychological impairment than adult rapists and, therefore, both groups should be distinguished. Furthermore, sex offenders show worse performance in neuropsychological measures than the general population, but this could result from the high levels of antisociality in some of these individuals, rather than a manifestation of their sexually aggressive predisposition. Consequently, individuals from the general population and non-sexual offenders must be considered. Finally, Joyal et al. (2014) emphasize the administration of measures aimed at tapping specific and clearly delineated cognitive factors, instead of using standard neuropsychological batteries. Joyal, Black, and Dasylva (2007) also highlighted the relevance of considering the moderating effect of IQ and education level on group differences between sexual offenders and controls.

The framework provided by Miyake et al. (2000), Friedman et al. (2006), and Friedman et al. (2008) will be applied in the present work. Miyake et al. (2000) analyzed three basic executive processes: inhibition, updating, and shifting/switching. These are basic cognitive processes that can be precisely measured through experimental tasks and, importantly, they support more complex executive tests. The antisaccade or the Stroop tasks measure inhibition processes, because they require the suppression of automatic responses. The Keep Track or the N-Back tasks are ideal for measuring updating processes, because they are based on the on-line adding and subtraction of varied amounts of information. Finally, the Number-Letter or the Category-Switch tasks tap shifting processes, because they are based on switching back and forth among subtasks. We note that Friedman et al. (2006) analyzed the relationships among inhibition, shifting, updating, fluid intelligence, and crystallized intelligence, finding that updating was highly correlated with intelligence, whereas shifting and inhibition were not.

Furthermore, previous research noted intelligence differences between sex and non-sex offenders. It is widely accepted that offenders have lower average intelligence scores than non-offenders (Wilson & Herrnstein, 1985). Cantor, Blanchard, Robichaud, and Christensen (2005) reported meta-analytic evidence of lower intelligence scores in sex offenders compared to non-sexual offenders. Guay, Ouimet, and Proulx (2005) compared the IQ scores of sex offenders and non-sexual violent criminals, finding significant differences, especially in non-verbal IQ. Therefore, intelligence might be a relevant psychological factor when sex offenders are compared with other groups.

The main goal of the present investigation is to obtain theory-based measures of executive function in sex offenders' subtypes. Specifically, we will distinguish between rapists (with adult victims) and child abusers. Furthermore, two comparison groups will be assessed: community controls and non-sexual incarcerated offenders. The simultaneous comparison among these groups might help to achieve a refined characterization of the cognitive processes involved in sexual assault. The administered executive function measures tap elementary and well-defined cognitive processes (inhibition, shifting, and updating) following Joyal et. al. (2014) recommendations. Finally, age, educational level, and IQ (both verbal and non-verbal) will be also considered in order to overcome limitations noted in previous research (Joyal et al., 2007). Previous findings obtained using the same measures administered here suggest that offenders will show lower fluid intelligence and executive updating scores than controls (Herrero, Escorial, & Colom, 2010). However, in the present study offenders are separated into three groups – non-sex offenders, rapists, and child abusers – due to the heterogeneity of their cognitive profiles.

Method

Participants

The 26 rapists considered here had a mean age of 37.8 years (SD = 8.87). Their mean number of years of education completed was 8.5 (SD = 2.8). They had assaulted a mean of 3.2 victims (SD = 6.5), with a minimum of 1 and a maximum of 33 victims. Victims' mean age was 31.5 years (SD = 19.21) and ranged from 15 to 84 years. All of them were Spaniards, except two participants who were of Portuguese and Ukrainian origin. All were convicted for at least one sexual crime. None was convicted for non-sexual crimes.

The 17 child abusers had a mean age of 44.0 years (SD = 11.5). Their average number of years of education was 8.09 (SD = 2.87). They had abused a mean of 1.3 victims (SD = 0.68), ranging from a minimum of 1 and a maximum of 3. Mean victim's age was 10.32 years old (SD

= 2.54), ranging from 5.5 to a maximum of 13. One participant in this group was Ecuadorian.

The 35 non-sexual offenders had a mean age of 34.84 years (*SD* = 8.17). Their average number of years of education was 8.8 (*SD* = 2.45). Their criminal records included, homicide (2), theft (9), bank robbery (1), intimate partner violence (2), aggression (1), drug trafficking (6), fraud (2), and forced prostitution of irregular foreigner citizens (2). In the male prison population of Spain, these offences account for approximately 72% of the offences (Secretaría General de Instituciones Penitenciarias, 2015). Thus, the considered group includes the most common criminal behaviors in the country and, therefore, can be considered an appropriate comparison group.

One public announcement was made at the prison units and participants volunteered for the study. Offenders did not receive any compensation for their participation. All signed a written informed consent. Neuropsychological testing was conducted exclusively for research purposes. The *Secretaría General de Instituciones Penitenciarias* provided the required ethical approval. Participants were not diagnosed of any major psychiatric disorder and had no clinical history of brain injury.

Finally, the 32 community controls had a mean age of 29.0 years (*SD* = 2.37). Their average number of years of education was 7.87 (*SD* = 0.98). They were recruited among relatives and friends of a group of Psychology students who were instructed to choose men as alike as possible to the offenders with respect to age and educational level.

Measures and Procedure

The three executive tasks administered by Herrero et al. (2010) were considered in the present study (Figure 2, left panels). Updating was measured by the Letter Memory Task (LMT), switching/shifting by the Number-Letter Task (NLT), and inhibition by the Simon Task (ST).

In the LMT, letters are presented for 1,000 ms per letter and participants were asked to remember the last four letters presented by mentally adding the most recently presented letter and deleting the fifth letter back. At least three practice trials were completed, with a length of seven letters. Practice trials were repeated until participants reached an appropriate knowledge of the task. There were six experimental trials of varying length (15, 17, 19, 21, 23, 25) randomly presented, for a total of 24 letters recalled (top performance of four letters remembered in six trials). The dependent measure was the number of letters that participants could correctly remember.

In the NLT, a number-letter pair (2C) was presented in one of four quadrants on the computer screen (top left, top right, bottom right, and bottom left). Participants were asked to indicate whether the number was odd (by pressing the computer key 1) or even (by pressing the computer key 0) (2, 4, 6, and 8 for even; 3, 5, 7, and 9 for odd) when the number-letter pair was presented in either of the top two quadrants. They also had to decide whether the letter was a consonant (by pressing the computer key 1) or a vowel (by pressing the computer key 0) (G, K, M, and R for consonant; A, E, I, and U for vowel) when the stimulus was presented in either of the bottom two quadrants. The number-letter pair was presented only in the top two quadrants for the first block of 32 trials and only in the bottom two quadrants for the second block of 32 trials. Afterwards, the stimulus was presented following a clockwise rotation around all four quadrants for the last block of 128 trials. The trials within the first two blocks required no task switching/shifting, whereas half of the trials in the third block required participants shifting between two different forms of categorization operations. In all trials, participants responded pressing a computer key (1 for even or vowel and 0 for odd or consonant) and the next number-letter pair was presented 150 ms after the response. Shift/switch costs were operationalized as the difference between the average RTs of the trials in the third block where a mental shift was required (trials from the upper left and lower right quadrants) and the average RTs of the trials from the first two blocks in which no shifting was necessary. Only RTs in the third block were of interest here.

The ST requires making a decision regarding an arrow (horizontally depicted) pointing to the left (by pressing the computer key 1) or to the right (by pressing the computer key 0) with respect to a fixation point (a cross). The target arrow pointing to a given direction (e.g., to the right) can be presented at the left (e.g., incompatible) or at the right (e.g., compatible) of the cross. There were a total of 32 practice trials and 80 experimental trials. Half of the trials were compatible and were randomly presented across the whole session. The main dependent measure was the mean RT for incompatible trials minus the mean RT for compatible trials. However, both RTs are also reported separately because (a) the subtraction neglects the fact that some participants are faster than others and (b) participants must exert a significant attentional control when there is a real conflict or incompatibility (Colom et al., 2008).

These three executive tasks were administered using a laptop.

Non-verbal (fluid) and verbal intelligence were measured by the Matrices and Similarities subtests from the WAIS-III. The standardization of the WAIS-III for Spain shows a four-factor structure comprising Verbal Comprehension, Perceptual Organization, Working Memory, and Processing Speed. The Matrices subtest is included in the perceptual organization factor, whereas the Similarities subtest is included in the verbal comprehension factor (Wechsler, 1997).

All participants were tested individually. Incarcerated offenders were tested within the penitentiary center facilities, in an isolated office, for avoiding distractions. Members of the control group were tested in a Psych. laboratory located at *Colegio Universitario Cardenal Cisneros* (Madrid). The executive tasks were administered first, and the intelligence tests were administered in a second session. There was a resting time of 15 min between sessions.

Analyses

ANOVAs were computed for testing group differences in the measures of interest. Because homocedasticity and normality assumptions were not met for "Education (years)" and "Inhibition (Simon)", non-parametric tests (Kruskal-Wallis test) were computed.

Post hoc analyses were computed when significant group differences were found in ANOVA analyses. Bonferroni corrections were applied using a p level of .008 (.05/6). Effect sizes (Cohen's d) were computed for the significant differences only.

Finally, we tested if observed differences remained after controlling for the effect of correlated variables using covariance analyses (ANCOVA).

Results

Table 1 shows the descriptive statistics for the four groups (controls, non-sex offenders, rapists, and child abusers) along with F and η^2 values. Specific variables for the Number-Letter (switching) and Simon (inhibition) tasks are also shown.

ANOVA analyses revealed statistically significant group effects for age, the Matrices subtest from the WAIS-III (fluid reasoning), and Updating (Letter Memory Task). Therefore, post hoc comparisons were computed for these variables only.

Regarding age, controls were younger than sex offenders (p < .001, d = -1.43) and child abusers (p < .001, d = -2.21), but there were no significant differences between controls and non-sex offenders (p = .035). Child abusers were older than non-sex offenders (p < .001, d = 1.01), but no significant differences were observed between child abusers and sex offenders (p = .033). No significant age differences were identified between rapists and non-sex offenders (p = 1.00).

Table 1. Descriptive Results (Means, *M*, and Standard Deviations, *SD*) for Community Controls, Non-sexual Offenders, Adults Sex Offenders (Rapists), and Child Abusers (*F*, *p*, and η^2 values are also shown)

	Controls (n = 32)		Non-sexual Offenders (n = 25)		Adult Sex Offenders (n = 26)		Child Abusers (n = 17)		$F(3, 96)$	η^2
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*		
Age	29.00	2.37	34.88	8.18	37.85	8.87	44.76	11.51	16.17**	.336
Education (years)[1]	7.88	0.98	8.88	2.46	8.38	2.97	8.71	3.02	3.07	.029
IQ Matrices	103.84	10.28	96.16	14.55	87.43	12.81	100.94	15.35	8.20**	.204
IQ Similarities	105.88	8.96	102.79	12.48	102.24	12.31	103.24	13.38	0.58	.018
Updating	14.31	3.75	11.84	4.74	8.04	5.44	9.12	5.86	9.24**	.224
Shifting	366.51	445.89	381.89	410.86	280.58	463.31	418.20	401.80	0.41	.013
Inhibition[1]	47.04	132.89	51.48	86.03	57.88	43.94	50.81	48.25	0.26	.002
Number-letter indices										
Shift 1	45,394.31	23,131.24	49,250.80	20,752.49	44,080.69	17,697.00	51,514.41	23,150.01	0.57	.018
No-Shift 1	32,159.09	15,010.20	33,796.44	11,362.56	33,576.27	13,719.03	38,658.88	20,235.59	0.72	.022
Shift 2	40,209.25	21,222.75	45,771.92	20,326.40	41,043.04	17,054.91	46,475.82	24,366.88	0.59	.018
No-Shift 2	29,913.59	13,586.27	31,572.72	10,103.49	31,714.96	11,013.97	32,693.35	15,596.00	0.21	.007
Simon indices										
Compatible (number correct)	39.79	0.63	39.80	0.50	39.16	2.23	39.82	0.53	0.94	.051
Incompatible (number correct)	38.93	1.74	39.04	1.88	39.28	1.37	38.94	1.20	0.25	.008
RT (compatible)	644.50	203.71	569.68	168.91	602.85	164.88	589.29	223.95	0.74	.023
RT (incompatible)	691.54	202.18	621.16	150.68	660.73	173.94	616.71	174.42	0.96	.030

Note. [1]Non-parametric test (Kruskal-Wallis).
IQ = intelligence quotient; RT = reaction time.
**$p < .001$.

There were no significant differences among groups in educational level (Kruskal-Wallis Test, $\chi^2(3, N = 100) = 3.074$, $p = .38$) and, therefore, the groups can be meaningfully compared on the psychological measures of interest (intelligence and executive functioning).

Figure 1 depicts scores obtained by the four groups on the Similarities and Matrices subtests. There were no significant group differences in the Similarities subtest, $F(3, 96) = .58$, $p = .633$, but these differences were significant in the Matrices subtest, $F(3, 96) = 8.20$, $p < .001$, $\eta^2 = .204$. Post hoc comparisons for this latter measure revealed that controls and child abusers show higher scores than rapists ($p < .001$, $d = 1.43$ and $p = .007$, $d = 0.98$, respectively). Thus, rapists with adult victims were the group showing the lower level of fluid reasoning, whereas child abusers performed similarly to community controls ($p = .91$) and non-sex offenders ($p = .71$).

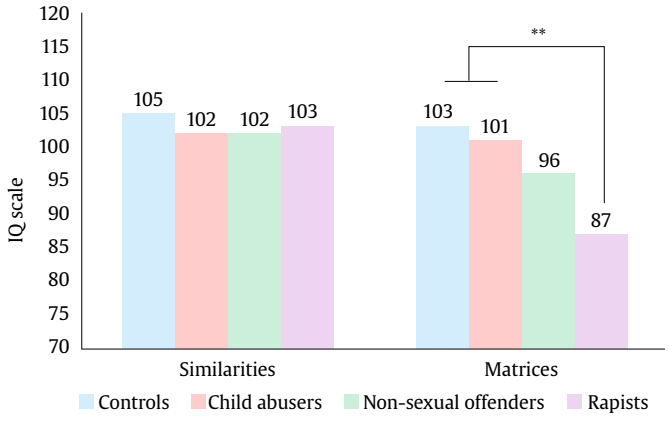

Figure 1. Intelligence Scores for Controls ($N = 32$), Child Abusers ($N = 17$), Non-Sex Offenders ($N = 25$) and Rapists ($N = 26$).
Note. Crystallized intelligence is measured by the Similarities subtest, whereas abstract-fluid reasoning is measured by the Matrices subtest from the WAIS-III. Rapists show worse scores on the Matrices subtest than community controls and child abusers.

With respect to the executive tasks (Figure 2, right panels), group differences in the Number-Letter (switching) and Simon (inhibition) tasks were no significant (Table 1). However, significant differences were observed in the Letter Memory (updating) Task, $F(3, 96) = 9.24$, $p < .001$, $\eta^2 = .224$.

Post hoc comparisons computed for the Letter Memory Task revealed that controls show better performance than rapists ($p < .001$, $d = 1.37$) and child abusers ($p = .003$, $d = 1.13$). There were no significant differences between controls and non-sexual offenders.

Finally, using ANCOVA analyses, we tested if the observed average difference in fluid reasoning (Matrices) and executive updating (Letter Memory) remains when their covariation is controlled. Differences in fluid reasoning were still statistically significant when updating was controlled, $F(3, 95) = 4.96$, $p = .003$, $\eta^2 = .135$. Also, differences in executive updating were still significant when fluid reasoning was controlled, $F(3, 95) = 5.91$, $p < .001$, $\eta^2 = .157$. Therefore, the covariation between fluid reasoning and executive updating did not change the main finding.

Discussion

Here we have shown that rapists and child abusers do have worse performance than controls in executive updating. Rapists also showed lower performance in a key measure of abstract-fluid intelligence (Matrices from the WAIS-III). This can be considered a solid finding because the four groups were equivalent regarding their educational level. The four groups showed the same average performance level in the Similarities subtest from the WAIS-III tapping verbal intelligence.

Furthermore, rapists and child abusers did not differ from controls in inhibition and switching/shifting executive processes. Herrero et al.

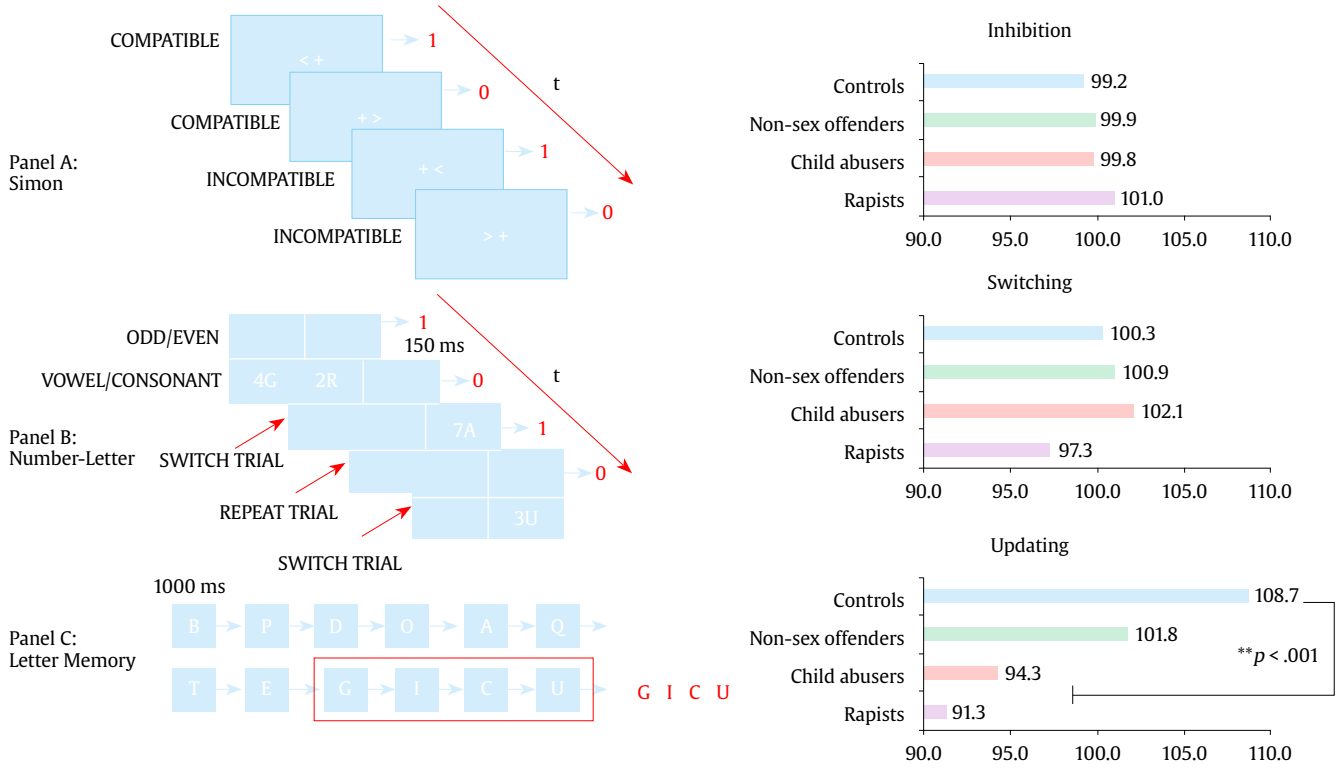

Figure 2. Left panel shows examples of the Simon Task (inhibition, panel A), Number-Letter Task (switching/shifting, Panel B), and Letter-Memory Task (updating, panel C). The right panel depicts results for these three executive measures for community controls, non-sex offenders, child abusers, and rapists. Scores are standardized for comparison purposes. Higher values on inhibition reflect worse performance, whereas higher values on switching and updating reflect better performance. Sex offenders (child abusers and rapists) show worse performance, compared with controls, in the task tapping executive updating (Letter Memory) (right panel C).

(2010) reported significant average differences between controls and prison inmates in abstract-fluid intelligence and executive updating, but differences in verbal-crystallized intelligence, shifting, and inhibition were absent. However, they underscored that it might be possible to observe different results when comparing homogeneous groups. This was one key goal in the present study and the results now uncover the fact that sex offenders account for the previously identified average difference between prison inmates and controls. Therefore, the conclusion that prison inmates, in general, show worse performance in fluid reasoning and updating executive processes is not warranted. This is a novel contribution that may have relevant applications.

Regarding intelligence, the findings reported here are consistent with Guay et al. (2005). These researchers failed to find average differences in verbal intelligence between sex offenders and non-sexual offenders, but the difference in performance IQ was highly significant: non-sexual offenders showed better performance. The present study adds to these findings showing that worse indices of abstract-fluid intelligence may or may not be associated with basic updating executive processes: low scores in both fluid reasoning and executive updating were observed in rapists, whereas child abusers did show (a) fluid intelligence scores equivalent to those observed for controls and (b) executive updating performance scores equivalent to rapists. Guay et al. (2005) did not compute separate analysis for child abusers and rapists, which is seen as a significant factor in the present study.

The findings observed here suggest that offenders do not show worse general executive control. It is also highlighted that they do not show lower general intelligence performance. Non-sex offenders score on a par with controls, matched by educational level, in intelligence and executive functioning. However, a) rapists show lower scores than child abusers and controls in fluid reasoning, and b) sex offenders (rapists and child abusers) show worse scores in executive updating than controls and non-sex offenders. The observed difference in fluid reasoning between rapists and child abusers cannot be attributed to differences in their antisocial levels, because non-sexual offenders show better scores than sex offenders. In their meta-analysis, Cantor et al. (2005) did not find differences between sex offenders with adult victims (rapists) and non-sexual offenders, but they highlighted that this could be attributed to the restricted number of available observations.

The results reported here suggest a specific link between worse performance in cognitive updating and sexual offending. This can be interpreted relying on the concept of cognitive deconstruction, applied to sexual offending by Ward, Hudson, and Marshall (1995). Sex offenders are thought to suspend self-regulatory processes across the offence chain. Cognitive deconstruction might explain the absence of normalized self-regulatory processes. Emotional and cognitive characteristics increase the risk of offending in vulnerable individuals. At a cognitive level, it involves self-serving, superficial and simplistic thinking, and a restricted attentional focus on concrete issues of the situation, especially those that confirm a distorted view of victim's compliance, along with filtering expressions of pain or distress. The individual shifts away from higher levels of abstract reasoning to focus on a concrete level, which allows him/her to avoid negative self-evaluation and the consequent negative feelings.

We suggest that a failure in executive updating might be one key cognitive process underlying mental deconstruction. Sex offenders often report feeling disconnected from the surrounding world during their offences and seem to ignore clear signs of rejection and distress displayed by their victims during the assault. This could be partially explained by a failure in successfully incorporating new information into the working memory system. Vulnerable individuals with a worse performance in executive updating, in conjunction with psychosocial

risk factors (e.g., low empathy), and situational elements (like alcohol or drugs) may depress the efficient processing of key environmental cues related with the abusive nature of their behavior (Abbey, Zawacki, Buck, Clinton-Sherrod, & McAuslan, 2004; Soderstrom, Tullberg, Wikkelsö, Ekholm, & Forsman, 2000). Furthermore, they may focus their attention on factors confirming their more accessible biased cognition. The results observed in the present study support the view that rapists and child abusers share this disruptive process. Therefore, performance in executive updating tasks might provide an interesting link between information processing and the construction of cognitive distortions.

Observed fluid reasoning performance may have also implications for clinical practice. Most treatment programs designed for sex offenders target therapeutic goals such as empathy or cognitive distortions (Mann & Marshall, 2009). These psychological facets are highly abstract. Participants are required to assimilate these concepts within their own psychological experience, trying to use them to gain a better understanding of human behavior. Moreover, offenders must anticipate how these psychological features would affect them in future circumstances, for building a realistic relapse prevention strategy. In their Risk-Need-Responsivity (RNR) model, Bonta & Andrews (2017) suggest that programs must be adapted to offenders' characteristics. We acknowledge that this model can be questioned on several grounds (Basanta, Fariña, & Arce, 2017), but the implication that efficient treatment programs designed for sex offenders should take into account their limitations for abstract reasoning deserves attention. The absence of fluid reasoning deficits in child abusers, which are present in rapists, invites to designing treatment programs properly adapted to their specific criminogenic needs.

Verbruggen, McLaren, and Chambers (2014) model of cognitive control is consistent with the perspective endorsed here. This model is based on, using their own words, 'deconstruction': basic cognitive processes support complex behaviors. These researchers discuss implications of this perspective for promoting behavioral change. Within their framework, deficits in basic cognitive processes might be related with clinical disorders. The analysis of distinguishable processes may increase our understanding of executive control deficits, leading to new theory-driven clinical treatments and personalized interventions. Thus, for instance, training of proactive control processes may alleviate the effects of information overload (Jaeggi, Studer-Luethi, Buschkuehl, Su, Jonides, & Perrig, 2010).

Related with our key findings, Subramaniam et al. (2012) demonstrated that intensive computerized training aimed at improving cognitive processes, mainly based on working memory executive operations, was beneficial for increasing reality monitoring performance in schizophrenia patients. After training, these patients showed higher performance in executive functioning (attention, working memory, reliability of short-term memory representations) and, importantly, better overall quality of life in the follow-up done six months after completing the training program.

Colom et al. (2008) have shown that short-term memory capacity and executive updating predict individual differences in intelligence. In this regard, Martínez et al. (2011) concluded that fluid intelligence could be largely identified with basic short-term storage processes (encoding, maintenance, and retrieval). Together with research showing that adaptive cognitive training programs based on the N-Back Task (tapping mainly updating processes) might improve fluid intelligence performance (Au et al., 2014), we suggest that current sex offender treatment programs would benefit from the design and administration of these cognitive training programs. Properly designed cognitive training procedures would help to place these individuals in a better mindset for assimilating the abstract requisites of available treatment programs.

Nevertheless, the present research has some limitations. First, the number of administered tests and tasks was limited. Each executive function and intellectual factor was measured through one single test/task. Several measures of the same construct of interest are preferable (Colom et al., 2013), but testing time limitations puts strong constraints in this regard. Second, sample size may increase the risk of type II errors, albeit the precise categorization achieved here would be highlighted. Third, the moderating effect of pedophilia in neurocognitive difficulties should be considered: 50-60% of the individuals who commit child sexual abuse are pedophiles, while the remaining individuals tend to be antisocial or opportunistic offenders (Seto, 2008). Pedophiles, in comparison with non-pedophilic child offenders, display better neuropsychological performance in planning and abstract reasoning (Schiffer & Vonlaufen, 2011), whereas their visual perception and visual-motor integration are slower (Suchy, Eastvold, Strassberg, & Franchow, 2014). In contrast, non-pedophilic child abusers exhibit worse verbal memory and executive function (Eastvold et al., 2011; Schiffer & Vonlaufen, 2011). Deviant sexual interest was not assessed here, and the rate of pedophilia is unknown. This must be controlled in future studies. Fourth, one possible defensive attitude among participants cannot be dismissed, as long as this is a common phenomenon in psychological assessment conducted in forensic settings (Arce, Fariña, Seijo, & Novo, 2014). Finally, samples composition might be biased to some extent because of their non-random nature. Inmates volunteered to participate and this may exclude highly antisocial individuals who (a) refuse to participate and (b) show neuropsychological characteristics yet unexplored.

In conclusion, sex offenders (rapists and child abusers) share one key limitation in cognitive executive updating. Their lower fluid reasoning scores cannot explain this deficit, because child abusers did not differ from community controls in this regard. This finding might help to choose among alternative explanations of sex offending behaviors. Furthermore, treatment programs may benefit from this result. Cognitive training programs aimed at improving executive updating skills, such as the adaptive n-back program (Colom et al., 2013), may be helpful for correcting the executive deficit shared by sex offenders.

Conflict of Interest

The authors of this article declare no conflict of interest.

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