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Reference:

Dilliën Tineke, Goethals Kris, Sabbe Bernard, Brazil Inte.- Impairment of both reward and punishment learning in males who have sexually offended against a child
Sexual abuse : a journal of research and treatment - ISSN 1079-0632 - Thousand oaks, Sage publications inc, 2019, , UNSP 1079063219871579
Full text (Publisher's DOI): <https://doi.org/10.1177/1079063219871579>
To cite this reference: <https://hdl.handle.net/10067/1619750151162165141>

Impairment of both Reward and Punishment Learning in Males who have Sexually Offended Against a Child

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Conflict of Interest statement

All authors declare not to have any financial interest in the results of this study or any other conflict of interest and agree to transfer copyrights if the manuscript is accepted.

Author Note

Tineke Dillien was supported by a Dehousse mandate of the University of Antwerp (project number 42/FAO20000/6619). Inti A. Brazil was supported by a VENI grant (451-15-014) awarded by the Netherlands Organisation for Scientific Research (NWO). These funding sources had no involvement in the design, data analysis, or interpretation of the results.

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Prior studies suggest that persons with a sexual offense against a child (PSOCs) present with an impairment in learning from reinforcement, which may contribute to the behavioral dysregulation often seen in PSOCs. Therefore, gaining more insight into the nature of this impairment seems essential to better understand child sexual (re)offending. Using a passive avoidance task, we found that PSOCs ($n = 57$) have difficulties with selecting behaviors that are associated with reward and suppressing behaviors that are associated with punishment relative to non-offending men ($n = 33$), but not compared to persons with a non-sexual offense history ($n = 31$). The latter ability was particularly compromised in non-pedophilic PSOCs. By unravelling a source of pathology in the mechanisms that are involved in behavioral control, this study helps setting a step towards new, more tailored, therapeutic approaches.

Keywords: Child sex offenders, Forensic psychiatry, Reinforcement learning, Reward learning, Punishment learning

Impairment of both Reward and Punishment Learning in Males who have Sexually Offended against a Child

Sexual offending against children is a pervasive problem. It affects many people (Pereda, Guillerá, Forns, & Gomez-Benito, 2009), and has a devastating impact on victims and their families (Maniglio, 2009). Preventing child sexual abuse, but also reducing recidivism is, therefore, of paramount importance to societies around the world. In order to find therapeutic interventions that are successful in treating *persons with a sexual offense against a child* (PSOCs) and in reducing the risk of sexual recidivism, gaining a thorough understanding of the etiological and maintaining factors of child sexual abuse is essential.

One important contributing factor to the sexual abuse of a child, identified both in etiological models and in research on the risk factors for sexual recidivism, is a lack of self-control or a failure to control one's behavior (e.g., Hanson & Morton-Bourgon, 2005; Seto, 2019; Ward, Hudson, & Keenan, 1998). For example, the Motivation-Facilitation Model of sexual offending states that a sexual offense against a child will only occur when motivating factors (e.g., pedophilic preferences) interact with facilitating factors that drive behavioral control to be low (Seto, 2019). The failure to control one's behavior can be temporary as a result of state facilitation factors (e.g., intoxication), or enduring as a result of dysfunctions in the cognitive processes involved in monitoring and adapting behavior (i.e., trait facilitation factors). In line with this notion, the study of executive functions has gained significant interest in the literature on PSOCs in recent years.

Executive Dysfunctions in PSOCs

Executive functioning is an umbrella term used to refer to a set of cognitive processes that allow us to regulate and control our actions, and to engage in behavior that is consistent with our goals. Key cognitive processes are the ability to inhibit prepotent responses that are

elicited by a stimulus to select a more appropriate one (i.e., inhibitory control), the ability to adjust behavior in response to changing environmental conditions (i.e., cognitive flexibility), and the ability to temporarily store and manipulate information at the service of complex cognitive functions such as problem solving and reasoning (i.e., working memory) (Dajani & Uddin, 2015; Diamond, 2013; Suchy, 2009).

Previous studies focusing on executive functioning have shown the presence of executive dysfunctions in PSOCs (see Joyal, Beaulieu-Plante, & de Chantérac, 2014). Joyal, Black, and Dassylva (2007) assessed inhibitory control in a group of PSOCs by administering the Stroop Color-Word Test (Delis, Kaplan, & Kramer, 2001). In this task, participants are asked to name the color of the ink in which a color word is printed (i.e., participants say 'green' when the word 'red' is printed in green ink), which requires them to inhibit the impulse to read the word. PSOCs were found to score significantly worse than the normative sample, with a large between-group difference in the outcome measure ($d = 1.39$). Similarly, Schiffer and Vonlaufen (2011), who used a task in which participants are asked to respond to certain stimuli while inhibiting their tendency to respond to other stimuli (i.e., a Go/No-go task), concluded that both pedophilic and non-pedophilic PSOCs have difficulties with inhibition, relative to *persons with a non-sexual offense history* (PNSOs) and non-offending men. All group differences were large based on the Cohen's d statistic (pedophilic PSOCs vs. PNSOs and non-offending men: $d = 0.82$ and 0.83 , respectively; non-pedophilic PSOCs vs. PNSOs and non-offending men: $d = 1.21$ and 1.23 , respectively). Eastvold, Suchy, and Strassberg (2011) also studied inhibitory control in pedophilic and non-pedophilic PSOCs and came to a similar conclusion. In their study, medium to large differences were found between both groups of PSOCs and PNSOs (pedophilic PSOCs vs. PNSOs: $d = 0.91$; non-pedophilic PSOCs vs. PNSOs: $d = 0.65$), with pedophilic PSOCs exhibiting the poorest performance. Since performance on the inhibition tasks used in this study is dependent on work pace, this

latter finding does not necessarily mean that pedophilic PSOCs have worse inhibitory capabilities than non-pedophilic PSOCs. Instead, it could be explained by the slow performance speed that was evident in pedophilic PSOCs.

Regarding cognitive flexibility, both Schiffer and Vonlaufen (2011) and Eastvold et al. (2011) found small to medium, but statistically nonsignificant differences between pedophilic, non-pedophilic PSOCs, and PNSOs (d varied between 0.03 and 0.67 with respect to all outcome measures). When both groups of PSOCs were compared to non-offending men, Schiffer and Vonlaufen (2011) found that non-pedophilic PSOCs showed severe cognitive flexibility deficits, with large differences between non-pedophilic PSOCs and non-offending men on all outcome measures of the Wisconsin Card Sorting Test (WCST; Heaton, 1981) (d varied between 1.29 and 1.82). Pedophilic PSOCs and non-offending men only differed significantly on one of the outcome measures of the WCST, and this difference had a medium effect size ($d = 0.77$). In the WCST, participants are asked to classify cards according to a rule that they need to deduce from feedback (i.e., correct or incorrect). After a number of trials, the classification rule changes and participants need to adapt in order to perform optimally on the task. Consistent with the study by Schiffer and Vonlaufen (2011), Cohen, Nesci, Steinfeld, Haeri, and Galynker (2010) found that non-offending men and women outperformed pedophilic PSOCs with regard to one of the outcome measures of the WCST, with a Cohen's d of 0.82 (i.e., a large effect size). In the studies by Cohen et al. (2002) and by Kruger and Schiffer (2011), pedophilic PSOCs and non-offending men did, however, not differ on measures of cognitive flexibility.

Other studies have assessed working memory capacities in PSOCs. Using tasks that require participants to repeat sets of digits in reverse order (i.e., backward span tasks), Eastvold et al. (2011) found no differences between pedophilic PSOCs, non-pedophilic PSOCs, and PNSOs ($d = 0.04$ and $d = 0.01$, respectively) in working memory capacity.

Kruger and Schiffer (2011) compared pedophilic PSOCs and non-offending men on a span task that assessed the visuo-spatial subsystem of the working memory (i.e., a subsystem of the working memory that allows us to temporarily store and manipulate non-verbal or visual information), and showed that pedophilic PSOCs had intact visuo-spatial working memory capacity.

Taken together, both pedophilic and non-pedophilic PSOCs display executive dysfunctions, in particular inhibitory control and cognitive flexibility deficits, with medium to large differences between pedophilic PSOCs and non-offending men, and large differences between non-pedophilic PSOCs and non-offending men. This conclusion suggests that executive dysfunctions are associated with offense status (i.e., sexual offending behavior) rather than with pedophilia. Massau et al. (2017) provided evidence for this suggestion, at least with respect to inhibitory control. In this study, pedophilic and non-pedophilic PSOCs were compared not only to non-offending men, but also to non-offending pedophiles (i.e., pedophilic men who had not committed a hands-on child sexual offense). A small ($d = 0.36$), but significant main effect for offense status was found, suggesting that the offending groups (both the pedophilic and the non-pedophilic PSOCs) are impaired in their inhibitory control abilities relative to the non-offending men and the non-offending pedophiles. Kärger et al. (2017), who used a Go/No-go task, also found that the capacity for inhibitory control differentiates between offending and non-offending pedophiles, with the non-offending pedophiles outperforming the offending pedophiles. This difference was of medium size ($d = 0.53$). As the difference between the non-offending men and the offending pedophiles was small ($d = 0.08$), and the difference between the non-offending men and the non-offending pedophiles was statistically nonsignificant but still had a medium effect size ($d = 0.51$), Kärger et al. (2017) interpreted their findings as an indication for superior inhibitory control

abilities in pedophiles who refrain from offending relative to pedophiles who act on their impulses.

Whereas some attention has been given in the child sexual offender literature to the role of executive dysfunctions in explaining disrupted behavioral control, other cognitive processes that are also critically involved in behavioral control have been overlooked. One of the most widely studied processes involved in the inhibition of unwanted behavior by linking it with negative consequences, is reinforcement learning (Cools, 2008; Montague, Hyman, & Cohen, 2004).

Reinforcement Learning Impairments in Persons with Offense Histories

Reinforcement learning enables individuals to learn associations between their behavior/choices and the outcomes that follow. The outcomes can function as reinforcement and, in general, we try to optimize our behavior in such a way that the chance of obtaining high-valued outcomes (such as rewards) is maximized and negative outcomes are avoided (Behrens, Hunt, Woolrich, & Rushworth, 2008; Rushworth, Kolling, Sallet, & Mars, 2012). In addition to acquiring contingencies (i.e., acquisition), we also need to adapt when previously rewarded choices and behaviors are no longer appropriate (i.e., reversal learning). There is ample evidence that reinforcement learning has a neurobiological basis, with neuroimaging studies showing the involvement of a number of brain structures, including the amygdala, the orbitofrontal cortex, and the anterior cingulate cortex (Rushworth, Behrens, Rudebeck, & Walton, 2007). Disturbances in these brain structures and resulting reinforcement learning impairments have been well described in various psychiatric populations characterized by rigid and/or maladaptive behavior (e.g., Chen, Takahashi, Nakagawa, Inoue, & Kusumi, 2015; Fillmore & Rush, 2006; Itami & Uno, 2002; Maia & Frank, 2011; Solomon, Smith, Frank, Ly, & Carter, 2011; Waltz & Gold, 2007; Zalla, Sav, & Leboyer, 2009).

Given its role in the inhibition of antisocial behavior by forming associations between such behavior and negative consequences, reinforcement learning has also received attention in the offender literature, primarily in regard to violent offenders with psychopathy, a severe personality disorder typified by disrupted interpersonal and emotional functioning and enduring maladaptive and antisocial behavior (Blair, 2013; Hare, Hart, & Harpur, 1991). Studies have yielded consistent evidence that offenders with psychopathy present with impaired passive-avoidance learning (e.g., Blair et al., 2004; Newman & Kosson, 1986; Newman, Widom, & Nathan, 1985; von Borries et al., 2010). During passive-avoidance learning, participants learn to associate actions or choices with the occurrence of aversive outcomes (i.e., punishments) and to behave in such a way that these outcomes are avoided. Another learning impairment often seen in offenders with diagnosed psychopathy and in offenders with a sub-threshold score (i.e., a score between 20 and 30) on the Psychopathy Checklist – Revised (PCL-R; Hare, 2003) concerns a reduced ability to adapt when stimulus-outcome contingencies are reversed, also known as reversal learning (e.g., Brazil, Maes, et al., 2013; Budhani, Richell, & Blair, 2006; Dargis, Wolf, & Koenigs, 2017; Mitchell, Colledge, Leonard, & Blair, 2002; Mitchell et al., 2006).

Although psychopathy has been prominent in research on reinforcement learning in persons with offense histories, reversal learning and passive-avoidance learning impairments have also been found in non-psychopathic offender populations, such as violent offenders who have been diagnosed with antisocial personality disorder (De Brito, Viding, Kumari, Blackwood, & Hodgins, 2013). Thus, not only psychopathic offenders, but also non-psychopathic offenders with antisocial personality disorder are impaired in their ability to use reinforcement to shape their behavioral tendencies. Individuals who are not motivated to suppress behavioral tendencies after receiving punishment will have a larger inclination to act on their antisocial impulses. Thus, a reinforcement learning impairment can be regarded as a

factor that increases the likelihood that antisocial impulses will be acted upon. Examining whether reinforcement learning impairments also underlie the behavioral dyscontrol that is evident in PSOCs seems essential in order to gain a better understanding of child sexual (re)offending.

Reinforcement Learning Impairments in Persons with Sexual Offense Histories

Although little attention has been paid to reinforcement learning in the sexual offender literature, some recent studies suggest that PSOCs indeed do present with reinforcement learning impairments. Joyal, Tardif, and Spearson-Goulet (2018) administered the Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994) to 39 juveniles who had sexually offended (JSO) against child victims, 15 JSO against peer or adult victims, 41 adolescents with a non-sexual offense history, and 39 non-delinquent adolescents. In this task, participants are asked to earn as much money as possible by choosing cards from four decks. The selection of a card results in the gain or loss of money according to the reward-punishment schedule of the deck. Two of these decks are disadvantageous with high gains but also high losses. The other two decks yield small gains but also small losses and are, therefore, the more advantageous choices in the long run. Results showed that the JSO with child victims performed significantly worse than the non-delinquent adolescents ($d = 0.65$), with the JSO with child victims failing to use reward and punishment feedback to learn to avoid the disadvantageous choices. Leue, Brocke, and Hoyer (2008) examined reinforcement learning in a mixed group of persons with sexual offense histories that was divided in a paraphilic and a nonparaphilic subgroup. They found the non-paraphilic subgroup to be impaired in their ability to adapt behavior when stimulus-outcome contingencies changed relative to the paraphilic subgroup and the non-offending men. In a previous study, we extended these latter findings by showing that the reinforcement learning impairments remained present in a group that consisted solely of PSOCs (Dillien, Goethals, Sabbe, &

Brazil, 2019). In this study, a probabilistic reversal learning task was administered to a group of PSOCs, a control group of PNSOs, and a group of non-offending men. In this task, participants are required to use reward and punishment feedback to learn to choose the correct stimulus in six stimulus pairs, and to adjust their choice behavior when contingencies reverse. The results showed that PSOCs, especially non-pedophilic PSOCs, were impaired in their ability to acquire contingencies and to adjust their behavior when contingencies changed. The differences were found relative to non-offending men ($d = 0.65$), but not to PNSOs ($d = 0.26$).

Purpose of the Current Study

Whereas the prior studies showed that PSOCs have reinforcement learning impairments, the precise nature of these impairments remains unknown. Since reinforcement learning relies on a multi-faceted mechanism, the observed impairments could reflect disturbances in one or more of the cognitive operations involved in learning (Brazil, Hunt, et al., 2013). For example, it is still unknown whether the ability to learn from negative outcomes and the ability to learn from positive outcomes are similarly affected in PSOCs. The possibility that only one of the two types of outcomes may be affected in PSOCs is not unlikely given the evidence suggesting that reward versus punishment learning are mediated by distinct neural substrates, and that the effects of reward and punishment on reinforcement learning might differ within individuals (Strickland, Bolin, Lile, Rush, & Stoops, 2016; Xue et al., 2013). Blair et al. (2004) studied the modulatory effect of reward and punishment on learning during acquisition in offenders who have been diagnosed with psychopathy, and found that acquisition was modulated by reward in offenders with psychopathy, but not by punishment. These results indicate that offenders with psychopathy show a selective impairment in the formation of stimulus-punishment associations, whereas their ability to form stimulus-reward associations is intact. Thus, it could be the case that a similar imbalance in learning from reward versus punishment also exists in PSOCs. Understanding the specific

deficits in reinforcement learning would help us to understand how these impairments contribute to the maladaptive behaviors seen in PSOCs.

The main goal of the present study was to further specify the reinforcement learning impairments seen in PSOCs, by investigating the presence of learning impairments during acquisition, and examining the roles of reward versus punishment during learning. Our study included a sample of PSOCs and two control groups: a group of PNSOs, and a group of non-offending men. These two control groups were used because they provide complementary information; PNSOs share several similarities with PSOCs, such as having a history of criminal behavior, being imprisoned, and so forth. Differences between these two groups (or the lack thereof) can provide information about whether the hypothesized impairments are specific to PSOCs, but do not address the issue that PNSOs may also show impairments relative to the general non-offender population (see Brazil et al., 2012). Therefore, a sample of non-offending men is needed that serves as a baseline against which to measure the performance of persons with offense histories. Based on our previous results (Dillien et al., 2019), we expected PSOCs to suffer from learning impairments during acquisition, at least compared to non-offending men. Given that acquisition has only been studied as a unitary concept in PSOCs, it is difficult to predict how reward and punishment, respectively, influence reinforcement learning in this group. Additionally, the current study attempted to verify within-group differences among PSOCs during acquisition, as our previous study (Dillien et al., 2019) demonstrated that the reinforcement learning impairments were more severe in non-pedophilic PSOCs than in pedophilic PSOCs.

Method

We report how we determined our sample size, all data exclusion (if any), all manipulations, and all measures in the study (Simmons, Nelson, & Simonsohn, 2012). This study was part of a larger study on the cognitive functioning of PSOCs, involving 59 PSOCs,

33 PNSOs, and 36 non-offending men. A sample size calculation was performed before the start of the study. This analysis indicated that 140 participants (with PSOCs, PNSOs, and non-offending men being included in a ratio of 2:1:1) were required to achieve 80% power of detecting a difference of 0.6 standard deviations between PSOCs and control subjects. Due to time constraints, not all participants completed all cognitive tasks of the larger study. In total, 123 participants participated in this study, with the data of two participants (one PSOC and one PNSO) having to be excluded due to technical failures during measurement. Note that the current study partly overlaps with our previously published study (Dillien et al., 2019).

Sample

Both PSOCs and PNSOs were incarcerated at the time of the study and recruited from eight Flemish prisons in Belgium between February 2016 and July 2017. All PSOCs ($n = 57$) were convicted at least once for the sexual abuse of a child aged 13 or younger (24 offended against extrafamilial children, 24 against intrafamilial children, and 9 against both extrafamilial and intrafamilial children), with none of them receiving anti-androgen therapy. Of the PSOCs, 21 were classified as pedophilic, and 36 were classified as non-pedophilic. The presence of a pedophilic disorder was determined according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR) criteria (American Psychiatric Association, 2000). The DSM-IV-TR criterion A was assessed in three steps. First, the PSOCs that admitted to being sexually attracted to children were classified as pedophilic PSOCs by self-report. For the PSOCs that denied a sexual interest in children, the Screening Scale for Pedophilic Interest (SSPI; Seto & Lalumière, 2001) was used to verify self-reported sexual preferences. Those with a SSPI score of 0 or 1 were classified as non-pedophilic PSOCs, whereas those with a score of 4 or 5 were classified as pedophilic PSOCs. Finally, for the PSOCs that scored in the intermediate range on the SSPI (i.e., a score of 2 or 3), the viewing time paradigm from the Explicit and Implicit Sexual Interest Profile (EISIP;

Schmidt, Gykiere, Vanhoeck, Mann, & Banse, 2014) was administered and used for classification. Those PSOCs who showed longer viewing times for child images relative to adult images, were classified as pedophilic. All PNSOs ($n = 31$) were convicted at least once for a violent offense, including assault and battery, attempted murder, murder / manslaughter. These individuals had no criminal history of sexual offenses based on criminal records and reported no pedophilic sexual interest. The non-offending men ($n = 33$) were volunteers from the community who responded to an advertisement that was spread by social media, email, and word of mouth. These men were required to report no criminal convictions, as well as no pedophilic sexual interest.

All participants met the following inclusion criteria: being male, age between 18 and 65 years, an IQ above 79, no current or lifetime serious psychiatric (e.g., schizophrenia and bipolar disorder) or neurological disorder, and no substance abuse within the last 12 months. The study was approved by the medical ethics committee of the University of Antwerp. All participants gave written informed consent and were paid 10 euros for their participation in this study. Table 1 shows the demographic and clinical characteristics of all participants in this study. The characteristics are broken down for pedophilic and non-pedophilic PSOCs in Table 3.

Procedure

Eligible PSOCs and PNSOs were identified from prison records by prison psychologists, and subsequently invited to an information session in which a full explanation of the study was given. For those who were willing to participate, individual screening sessions were carried out to ensure that all participants met the inclusion criteria. To this end, a semi-structured interview, the Dutch version of the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I; Van Groenestijn, Akkerhuis, Kupka, Schneider, & Nolen, 1999), the Dutch version of the Structured Clinical Interview for DSM-IV Axis II Personality

Disorders (SCID-II; Weertman, Arntz, & Kerkhofs, 2000), and the Dutch version of the National Adult Reading Test (Nederlandse Leestest voor Volwassenen, NLV; Schmand, Bakker, Saan, & Louman, 1991) were administered. In addition to checking the inclusion criteria during the screening sessions, the Self-Report Psychopathy Short-Form (SRP-SF; Paulhus, Neumann, & Hare, 2015) was administered to investigate a possible confounding effect of psychopathic traits on the hypothesized reinforcement learning impairments in PSOCs, given that previous studies clearly demonstrated such impairments in offenders with psychopathy (e.g., Blair et al., 2004; Budhani et al., 2006).

Three PSOCs were excluded from this study based on the results of the screening sessions: two because of IQ-scores below 80 and one because of his history of psychosis. The participation rate was 71% for the PSOCs and 61% for the PNSOs. The non-offending men were screened using the same inclusion criteria and measures as for the persons with offense histories. After completion of the screening phase, testing sessions were planned and a passive avoidance task (Blair et al., 2004) was administered during one of two test sessions.

Measures

Semi-structured interview. A semi-structured interview developed especially for this study, was used to gather information on demographics, sexual behavior, psychiatric and neurological disorders, substance abuse, offending behavior, victim characteristics (only for the PSOCs), and criminal history. When possible, prison records were reviewed to validate the self-reported information regarding offending and offending history.

SCID-I and SCID-II (Van Groenestijn et al., 1999; Weertman et al., 2000). The SCID-I and the SCID-II are semi-structured instruments to assess DSM Axis I and Axis II disorders. Both instruments have fair to excellent inter-rater reliability, with kappa values varying between .61 and .83 for the Axis I disorders and between .77 and .94 for the Axis II disorders (Lobbestael, Leurgans, & Arntz, 2011).

The NLV (Schmand et al., 1991). This test was used as an estimate of intellectual functioning. It requires participants to correctly pronounce 50 irregular words from which a (verbal) IQ score is derived. The NLV has been shown to have a high correlation ($r = .85$) with verbal intelligence (Schmand et al., 1991).

The SRP-SF (Paulhus et al., 2015). The SRP-SF was administered to measure psychopathic traits. The SRP-SF consists of 29 items that yield four subscales: interpersonal manipulation, callous affect, erratic lifestyle, and criminal tendencies. These subscales are summed to form two factor scores (i.e., interpersonal-affective and impulsive-antisocial) and an overall psychopathy score. Recent studies have shown (nearly) acceptable to good internal consistency reliabilities for the four subscale scores (Cronbach's α ranges between .63 and .80) (e.g., Carré, Hyde, Neumann, Viding, & Hariri, 2013; Driessen et al., 2018). The construct validity of the SRP-SF has been demonstrated by relating SRP-SF scores to external correlates that are relevant to psychopathy, such as externalizing psychopathology and delinquent behavior (Neumann & Pardini, 2012).

The SSPI (Seto & Lalumière, 2001). The SSPI is a screening instrument to assess pedophilic sexual interests in PSOCs. It consists of 4 items concerning victim characteristics, that are scored as present or absent. SSPI scores have been found to correlate highly with other indicators of pedophilic interests (Pearson's correlations between SSPI scores and items of risk assessment instruments that measure pedophilic interests range from .51 to .70), and to predict sexual recidivism ($AUC = .64$) (Helmus, Ó Ciardha, & Seto, 2015).

The viewing time paradigm from the EISIP (Schmidt et al., 2014). The EISIP is a multi-method battery that includes both direct and indirect measures of pedophilic sexual interest. The viewing time task is one of the indirect measures of the EISIP. In this task, 80 images of individuals of varying sexual maturity, clothed in bathing suits, are shown on a computer screen. While PSOCs rate the sexual attractiveness of the images, viewing time is

recorded which is used as a measure of sexual interest. The reliability (Cronbach's α ranges between .90 and .95 for the images of girls, boys, women, and men) and the concurrent validity (Pearson's correlation between the viewing time task and the SSPI = .48) of the viewing time task have been demonstrated (Schmidt, et al., 2014).

Passive avoidance task (Blair et al., 2004). A computerized passive avoidance task was used that enabled us to separately observe the modulatory effects of reward and punishment on acquisition learning. Throughout this task, eight different numbers were displayed repeatedly eleven times (i.e., there were eleven blocks, each containing eight trials). Reacting to four of the numbers yielded points (i.e., reward), whereas reacting to the other four numbers resulted in the loss of points (i.e., punishment). Different reinforcement values were assigned to the individual numbers: Either +1, +50, +100, and +200 points for the numbers associated with reward or -1, -50, -100, and -200 points for the numbers associated with punishment. Participants were expected to learn to press the spacebar when a number associated with reward was presented, and refrain from pressing the spacebar when a number associated with punishment was displayed. After responding, feedback was presented to the participant to indicate how many points were won or lost. Participants were told to earn as many points as possible throughout the task. Performance on this task was measured by the number of commission errors (i.e., a response was made when it should not have been) and the number of omission errors (i.e., a response was omitted when it should have been made). The number of commission errors reflects the ability to form stimulus-punishment associations (i.e., punishment learning), whereas the number of omission errors reflects the ability to learn stimulus-reward associations (i.e., reward learning).

Data Analysis

Descriptive statistics and correlational analyses. One-way analyses of variances (ANOVA) were carried out to examine between-group differences in age, IQ, and

psychopathy scores. Correlation analyses were conducted to detect potential confounders (i.e., age, IQ, and level of psychopathy).

Passive avoidance task. Two separate mixed-design ANOVAs were performed on the number of commission errors and the number of omission errors (Blair et al., 2004; De Brito et al., 2013). In both analyses, Group (PSOCs, PNSOS, and Non-offending men) was the between-subjects factor, and Value and Block the within-subjects factors. The Value factor had 4 levels (-1, -50, -100, and -200 points for the analysis concerning commission errors and +1, +50, +100, and +200 points for the analysis concerning omission errors) and the Block factor had ten levels (Block 2 up to and including Block 11). The first block in which all numbers were presented for the first time was regarded as the learning block, and was not included in the analyses. The Greenhouse-Geisser correction was applied when the assumption of sphericity was violated. Planned comparisons and post-hoc tests were used after significant effects were found. Games-Howell post-hoc tests were conducted when the assumption of homogeneity of variance was violated. Secondly, the same mixed-design ANOVA model was used in a supplementary analysis to detect possible within-group differences among PSOCs. These two ANOVAs included Subgroup (Pedophilic PSOCs, Non-pedophilic PSOCs, and Non-offending men) as the between-subjects factor, and Value and Block as the within-subjects factors. All outcome measures and analyses were specified prior to commencing the study.

Results

Analysis for the Total Sample

Demographic and clinical characteristics of the study group. Although PSOCs and control subjects were recruited from the same IQ and age range, large between-group differences were found on these variables. The PSOCs ($M = 47.70$, $SD = 10.97$) were significantly older than the PNSOs ($M = 36.32$, $SD = 10.51$, $p < .001$, $d = 1.05$) and the non-

offending men ($M = 36.70$, $SD = 10.05$, $p < .001$, $d = 1.03$), with the two latter groups not differing from each other ($p = .999$, $d = 0.04$). The non-offending men ($M = 108.35$, $SD = 4.96$) scored significantly higher in IQ than the PSOCs ($M = 100.66$, $SD = 11.54$, $p < .001$, $d = 0.80$) and the PNSOs ($M = 97.55$, $SD = 8.97$, $p < .001$, $d = 1.49$), but no significant differences were found between the offender groups ($p = .369$, $d = 0.29$). The groups also differed in psychopathy levels. The PNSOs ($M = 76.58$, $SD = 20.04$) had significantly higher overall SRP-SF scores than the non-offending men ($M = 49.70$, $SD = 14.03$, $p < .001$, $d = 1.56$) and the PSOCs ($M = 61.80$, $SD = 13.92$, $p = .002$, $d = 0.90$), and the PSOCs had significantly higher overall SRP-SF scores than the non-offending men ($p = .001$, $d = 0.87$) (see Table 1).

Commission errors. The results showed a main effect for Block [$F(9, 1062) = 31.73$, $p < .001$, $\eta_p^2 = .21$]. Bonferroni-adjusted pairwise comparisons indicated that the error rates decreased from earlier to later blocks (Figure 1). There was also a significant main effect for Value [$F(3, 354) = 5.15$, $p = .003$, $\eta_p^2 = .04$]. Bonferroni-corrected pairwise comparisons indicated that more errors ($p = .008$, $d = 0.31$, 95% CI [0.02, 0.16]) were made on stimuli that were associated with the lowest punishment value ($M = .51$, $SE = .03$) versus stimuli that were associated with the second-to-lowest punishment value ($M = .42$, $SE = .03$). The difference between the error rate for stimuli associated with the lowest punishment value and stimuli associated with the second-to-highest punishment value ($M = .44$, $SE = .03$) failed to reach statistical significance ($p = .056$, $d = 0.28$, 95% CI [-0.01e-1, 0.14], see Figure 1). There was also a significant main effect for Group [$F(2, 118) = 5.03$, $p = .008$, $\eta_p^2 = .08$]. Games-Howell post-hoc analyses indicated that both PSOCs ($M = .50$, $SE = .03$) and PNSOs ($M = .52$, $SE = .04$) made significantly more errors ($p = .027$, $d = 0.59$, 95% CI [0.01, 0.26] and $p = .015$, $d = 0.71$, 95% CI [0.03, 0.29], respectively) than non-offending men ($M = .36$, $SE = .04$), while PSOCs and PNSOs scored comparably ($p = .890$, $d = 0.10$). No significant Block $\times$ Group

[$F(18,1062) = 0.62, p = .832$], Value $\times$ Group [$F(6,354) = 0.69, p = .635$], Block $\times$ Value [$F(27,3186) = 1.00, p = .468$], or Block $\times$ Value $\times$ Group [$F(54,3186) = 0.95, p = .589$] interactions were found.

Omission errors. A significant main effect was found for Value [$F(3,354) = 3.42, p = .025, \eta_p^2 = .03$]. Bonferroni-adjusted pairwise comparisons revealed significantly or near significantly more errors on stimuli associated with the lowest reward value ($M = .29, SE = .03$) versus stimuli associated with the highest reward value ($M = .19, SE = .02; p = .038, d = 0.37, 95\% CI [0.03e-1, 0.19]$), on stimuli associated with the lowest reward value versus stimuli associated with the second-to-highest reward value ($M = .21, SE = .03; p = .066, d = 0.27, 95\% CI [-0.03e-1, 0.16]$), and on stimuli associated with the second-to-lowest reward value ($M = .25, SE = .02$) versus stimuli associated with the highest reward value ($p = .085, d = 0.25, 95\% CI [-0.05e-1, 0.13]$, see Figure 2). The results also revealed a significant main effect for Group [$F(2,118) = 3.29, p = .041, \eta_p^2 = .05$], with Games-Howell post-hoc analyses indicating that PSOCs ($M = .29, SE = .02$) made significantly more errors ($p = .046, d = 0.48, 95\% CI [0.01e-1, 0.17]$) than non-offending men ($M = .20, SE = .03$). The error rates of the PNSOs ($M = .22, SE = .03$) were comparable to the PSOCs ($p = .139, d = 0.41$) and to the non-offending men ($p = .881, d = 0.12$). There was no main effect for Block [$F(9,1062) = 1.05, p = .388$], nor were there interaction effects between Block and Group [$F(18,1062) = 1.43, p = .150$], Value and Group [$F(6,354) = 0.25, p = .941$], Block and Value [$F(27,3186) = 1.02, p = .437$], and Block, Value, and Group [$F(54,3186) = 1.04, p = .400$].

Correlation analysis. The correlation analyses showed a significant negative correlation between IQ and the number of commission errors ($r = -.33, 95\% CI [-.49, -.15], p < .001$). No other significant correlations were found between the demographic and clinical variables and the number of commission errors or omission errors (Table 2).

Within-Group Analysis for PSOCs

Demographic and clinical characteristics of the pedophilic and the non-pedophilic PSOCs. Within-group differences among PSOCs were explored by comparing pedophilic PSOCs, non-pedophilic PSOCs, and non-offending men. Significant differences were found between the groups with respect to age, IQ, and overall psychopathy score. Post-hoc analyses showed that both the pedophilic PSOCs ($M = 45.76$, $SD = 12.82$, $p = .009$, $d = 0.81$) and the non-pedophilic PSOCs ($M = 48.33$, $SD = 9.75$, $p < .001$, $d = 1.23$) were significantly older than the non-offending men ($M = 36.70$, $SD = 10.05$). Both groups of PSOCs (pedophilic PSOCs: $M = 62.14$, $SD = 15.74$, $p = .006$, $d = 0.85$; non-pedophilic PSOCs: $M = 61.60$, $SD = 12.95$, $p = .002$, $d = 0.88$) also had a significantly higher overall psychopathy score than the non-offending men ($M = 49.70$, $SD = 14.03$). With respect to IQ, the pedophilic PSOCs ($M = 107.84$, $SD = 10.04$, $p = .001$, $d = 1.14$) and the non-offending men ($M = 108.35$, $SD = 4.96$, $p < .001$, $d = 1.51$) outperformed the non-pedophilic PSOCs ($M = 96.26$, $SD = 10.22$), with the pedophilic PSOCs and the non-offending men scoring equally ($p = .98$, $d = 0.07$) (see Table 3).

Commission errors. This analysis showed the same main effects as the primary analysis for Block [$F(9, 783) = 26.57$, $p < .001$, $\eta_p^2 = .23$] and for Value [$F(3, 261) = 4.80$, $p = .004$, $\eta_p^2 = .05$]. A main effect for Subgroup [$F(2, 87) = 4.01$, $p = .022$, $\eta_p^2 = .08$] was also present. Games-Howell post-hoc tests demonstrated that non-pedophilic PSOCs ($M = .52$, $SE = .04$) made significantly more errors ($p = .020$, $d = 0.67$, 95% CI [0.02, 0.29]) than non-offending men ($M = .36$, $SE = .04$). Pedophilic PSOCs scored in between ($M = .46$, $SE = .05$), not differing significantly from non-offending men ($p = .265$, $d = 0.43$) or non-pedophilic PSOCs ($p = .615$, $d = 0.26$). Similar to the primary analysis, this analysis found no interaction effects between Block and Subgroup [$F(18, 783) = 0.62$, $p = .824$], Value and Subgroup

[$F(6,261) = 0.14, p = .985$], Block and Value [$F(27,2349) = 1.32, p = .126$], and Block, Value, and Subgroup [$F(54,2349) = 1.22, p = .129$].

Omission errors. The main effect for Subgroup failed to reach significance [$F(2,87) = 2.45, p = .092, \eta_p^2 = .05$]. For the rest, the same pattern of significant and non-significant effects was obtained as in the primary analysis. A significant main effect was found for Value [$F(3,261) = 3.88, p = .013, \eta_p^2 = .04$], but not for Block [$F(9,783) = 0.91, p = .484$].

Furthermore, no significant interaction effects were found between Block and Subgroup [$F(18,783) = 0.60, p = .836$], Value and Subgroup [$F(6,261) = 0.47, p = .812$], Block and Value [$F(27,2349) = .69, p = .822$], and Block, Value, and Subgroup [$F(54,2349) = 1.04, p = .411$].

Correlation analysis. The correlation analyses showed a positive correlation between age and the number of commission errors ($r = .24, 95\% \text{ CI } [.04, .43], p = .020$). Furthermore, negative correlations were found between IQ and the number of commission errors ($r = -.26, 95\% \text{ CI } [-.45, -.04], p = .018$) and the number of omission errors ($r = -.26, 95\% \text{ CI } [-.45, -.04], p = .020$), respectively (Table 4).

Discussion

In the present study, PSOCs were found to be impaired in their ability to use reinforcement to acquire contingencies compared to non-offending men, and learning from both reward and punishment was disrupted. Our previous study, with an overlapping sample, indicated that PSOCs had a general reinforcement learning impairment that affected both acquisition and reversal learning (Dillien et al., 2019). The current study provided further evidence for the presence of a learning impairment during acquisition in PSOCs by showing that PSOCs made more errors when acquiring stimulus-outcome associations relative to non-offending men. The present study, moreover, specified these prior findings obtained in PSOCs by parsing acquisition learning into the ability to associate stimuli with punishment and the

ability to associate stimuli with reward. The results point out that both capacities are compromised in PSOCs compared to non-offending men, with (near-)medium effect sizes. Finally, our additional analyses showed within-group differences among PSOCs during acquisition, with non-pedophilic PSOCs being particularly impaired in the acquisition of stimulus-punishment associations compared to non-offending men. Because of the relatively small sample sizes for the separate subgroups of PSOCs, the latter result should be regarded as tentative and needs further investigation.

Our findings suggest that PSOCs have difficulties with selecting behaviors that are associated with reward and suppressing behaviors that are associated with punishment compared to non-offending men. This inability to modulate behavior in the service of reinforcement interferes with their ability to control their behavior, which is included in sexual offender models as a factor that contributes to child sexual (re)offending (e.g., Seto, 2019). Following the general theory of crime (Gottfredson & Hirschi, 1990), the role of a failure in behavioral control is not specific to child sexual offending. Rather, it is a common factor in all individuals who commit offenses, which implies that other offender groups also show an impairment in their ability to use reinforcement to regulate their behavior. Empirical evidence indicates that this is the case for punishment learning, with studies demonstrating that both offenders with psychopathy and violent offenders with antisocial personality disorder are impaired in their ability to form stimulus-punishment associations, which is believed to contribute to their deficiency in behavioral inhibition (Blair et al., 2004; De Brito et al., 2013; Newman & Kosson, 1986; Newman et al., 1985; von Borries et al., 2010). The finding that the PNSOs in this study also showed a reduced ability to learn stimulus-punishment associations compared to the non-offending men provides further evidence that the punishment learning impairment is a shared feature among persons with offense histories, rather than being specific to PSOCs. The link between impaired punishment learning and

antisocial behavior is not surprising, and parallels the notion that people who engage in antisocial behavior do not seem to be motivated to inhibit antisocial behavioral tendencies when faced with the prospect of negative outcomes. Although an inability to learn from reward may also interfere with behavioral control, such an impairment may be specific to PSOCs. The lack of a statistically significant difference with only a small observed effect size between the PNSOs and the non-offending men in reward learning indicates that the capacity to learn from rewards is intact in persons with violent offense histories, suggesting that the reward learning impairment that is observed in PSOCs is not a common factor among persons with offense histories. However, the finding that the PNSOs also did not differ significantly from the PSOCs points out that this interpretation should be made with care.

Importantly, the present results are consistent with the previously described hypothesis (Dillien et al., 2019) that PSOCs are less able to form accurate representations of outcome expectancies (see also Brazil, Mathys, Popma, Hoppenbrouwers, & Cohn, 2017). Working in concert with other brain regions, the amygdala is believed to play a central role in this process (Cador, Robbins, & Everitt, 1989; Kosson et al., 2006). By forming representations of the outcome value and linking these to stimuli, the amygdala turns ‘neutral’ stimuli into stimuli that predict positive or negative outcomes, prompting approach or avoidance behavior (Baxter & Murray, 2002; Murray, 2007). When the ability to form accurate representations of outcome expectancies is impaired, however, individuals are less sensitive to the reinforcing value of stimuli and demonstrate suboptimal choice behavior, as was seen in PSOCs. Given that both the amounts of commission and omission errors were higher in PSOCs than in non-offending men, this deficit probably concerns a general disruption of outcome representations, involving both punishment and reward expectancies (Blair et al., 2004). The importance of accurate representations of outcome expectancies for optimal reinforcement learning was clearly demonstrated by White and colleagues (White et al., 2016; White et al., 2013), who

found a link between the poor performance of youngsters with conduct problems on a passive avoidance task and a diminished use of outcome expectancies when demonstrating avoidance behavior. In addition, Brazil et al. (2017) found that impulsive-irresponsible and callous-unemotional traits, which are often elevated in persons with offense histories, were associated with the formation of less accurate (i.e., more uncertain) expectations concerning changes of contingencies. Taken together, these prior studies are in line with our novel proposal that PSOCs are impaired in generating optimal expectations and mental representations during reinforcement learning.

Our findings also have clinical implications. Since reinforcement learning impairments interfere with behavioral control, enhancing existing offender programs by interventions that target the reinforcement learning mechanism could be helpful to reduce the risk of sexual recidivism in PSOCs (cf. Baskin-Sommers, Curtin, & Newman, 2015). In addition, it is important to consider that the presence of reinforcement learning impairments may undermine the capacity of PSOCs to benefit maximally from therapy, which could explain why some PSOCs fail to obtain desired therapeutic effects. Whereas PSOCs generally succeed in leading a crime-free, 'normal' life after sentence and treatment (Hanson, Bourgon, Helmus, & Hodgson, 2009; Lösel & Schmucker, 2005), some subgroups keep struggling. They fail to attain social and vocational functioning and/or have an increased risk to reoffend either sexually or non-sexually despite undergoing specialized therapeutic interventions (Harris & Hanson, 2004; Vess & Skelton, 2010). The lack of therapeutic progress in these PSOCs could be partly due to a reinforcement learning impairment, which interferes with the capacity to change behavior in response to treatment. Thought should be given to how treatment should be tailored to meet the needs of PSOCs who are severely impaired in their reinforcement learning abilities (i.e., responsivity principle; Bonta & Andrews, 2016; Harkins & Beech, 2007). Matching interventions to the cognitive abilities and learning style of these individuals

may enhance the chances of a good treatment response for a group who would otherwise potentially struggle to obtain therapeutic goals.

Despite the advances offered by our study, it remains important to consider that one important limitation of our study is that the PSOCs, the PNSOs and the non-offending men differed statistically with respect to age and IQ, although participants were recruited from a similar age and IQ range. Whereas previous studies that used a similar passive avoidance task did not consistently demonstrate an effect of age and/or IQ on acquisition learning performance (Blair et al., 2004; De Brito et al., 2013), our correlation analyses showed that age and IQ were correlated with the number of errors that were made. It is, therefore, possible that the weaker performance of the PSOCs during acquisition learning can be (partly) explained by their lower IQ and/or their older age. Due to the fact that these variables were not independent from the grouping variable, we were unable to test the explanatory power of the variables as covariates (Field, 2013; Miller & Chapman, 2001; Owen & Froman, 1998; Suckling, 2011). Further studies in which PSOCs and control subjects are matched on age and IQ are necessary to untangle the influence of these variables on acquisition in PSOCs. Another limitation is that no real rewards or punishments were given to the participants in this experimental design, making it possible that participants were not sufficiently motivated to learn. Future studies could employ reinforcement learning tasks that incorporate reinforcers that are subjectively meaningful for each participant, which could help account for individual differences in the subjective value assigned to different reinforcers (Glimmerveen, Brazil, Bulten, & Maes, 2018).

Conclusion

Our findings indicate that PSOCs are impaired in their ability to acquire stimulus-reward and stimulus-punishment contingencies during reinforcement learning compared to non-offending men, which may disrupt the ability to control their behavior. Our results

provide a new view on the possible mechanisms involved in the commission of a child sexual offense. By systematically unravelling the sources of pathology within the mechanisms that are involved in behavioral control, this line of work helps pave the way towards more refined diagnosis and tailored treatment (Insel & Cuthbert, 2015), thus offering the possibility of improving therapeutic outcomes for PSOCs.

Acknowledgement

The authors take responsibility for the integrity of the data, the accuracy of the data analyses, and have made every effort to avoid inflating statistically significant results.

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Table 1

Demographic and Clinical Characteristics of All Participants

Variable	PSOCs			PNSOs			Non-offending men			Analysis		
	<i>M</i>	<i>SD</i>	Range	<i>M</i>	<i>SD</i>	Range	<i>M</i>	<i>SD</i>	Range	Statistic	<i>p</i>	Post-hoc
Age (years) ^a	47.70	10.97	22-65	36.32	10.51	20-60	36.70	10.05	19-64	16.76 ^d	<.001	PSOCs > PNSOs ^{***} PSOCs > NO ^{***} NO = PNSOs
IQ (NLV) ^b	100.66	11.54	84-130	97.55	8.97	80-113	108.35	4.96	95-118	21.11 ^e	<.001	NO > PSOCs ^{***} NO > PNSOs ^{***} PSOCs = PNSOs
SRP-SF Tot ^c	61.80	13.92	37-104	76.58	20.04	48-124	49.70	14.03	31-76	19.76 ^e	<.001	PSOCs > NO ^{**} PNSOs > NO ^{***} PNSOs > PSOCs ^{**}
SRP-SF F1 ^c	29.04	7.08	14-47	32.52	9.35	17-54	25.70	8.31	14-46	4.73 ^e	.012	PNSOs > NO ^{**} PSOCs = NO PSOCs = PNSOs
SRP-SF F2 ^c	32.77	8.25	19-57	44.06	11.56	23-70	24.00	6.91	15-39	37.55 ^e	<.001	PSOCs > NO ^{***}

PNSOs > NO^{***}

PNSOs > PSOCs^{***}

Note. PSOCs = Persons with a sexual offense against a child; PNSOs = Persons with a non-sexual offense history; NO = Non-offending men; NLV = ‘Nederlandse Leestest voor Volwassenen’, Dutch version of the National Adult Reading Test; SRP-SF Tot = Self-Report Psychopathy Short-Form Overall psychopathy score; SRP-SF F1 = Self-Report Psychopathy Short-Form Interpersonal-affective; SRP-SF F2 = Self-Report Psychopathy Short-Form Impulsive-Antisocial.

^a *n* PSOCs = 57, *n* PNSOs = 31, *n* non-offending men = 33. ^b *n* PSOCs = 50, *n* PNSOs = 31, *n* non-offending men = 31 (7 PSOCs and 2 non-offending men did not complete the NLV due to Dutch not being their native language). ^c *n* PSOCs = 56, *n* PNSOs = 31, *n* non-offending men = 33 (1 PSOC could not complete the SRP-SF due to time constraints). ^d F ANOVA, Bonferroni corrected post-hoc tests. ^e Welch ANOVA, Games-Howell post-hoc tests.

^{**} $p < .01$. ^{***} $p < .001$.

Table 2

*Pearson Correlations between Demographic / Clinical Characteristics and Outcome**Measures for All Participants*

Variable	Commission Errors		Omission Errors	
	<i>r</i>	95% CI	<i>R</i>	95% CI
Age (years) ^a	.18	[-.02, .35]	.17	[-.01, .34]
IQ (NLV) ^b	-.33***	[-.49, -.15]	-.18	[-.35, .01]
SRP-SF Tot ^c	.14	[-.04, .31]	-.04	[-.22, .14]
SRP-SF F1 ^c	.18	[-.01, .35]	-.08	[-.26, .10]
SRP-SF F2 ^c	.09	[-.09, .27]	-.01	[-.19, .17]

Note. *r* = Pearson correlation coefficient, CI = confidence interval, NLV = 'Nederlandse Leestest voor Volwassenen', Dutch version of the National Adult Reading Test; SRP-SF Tot = Self-Report Psychopathy Short-Form Overall psychopathy score; SRP-SF F1 = Self-Report Psychopathy Short-Form Interpersonal-affective; SRP-SF F2 = Self-Report Psychopathy Short-Form Impulsive-antisocial.

^a *n* = 121. ^b *n* = 112 (7 PSOCs and 2 non-offending men did not complete the NLV due to Dutch not being their native language). ^c *n* = 120 (1 PSOC could not complete the SRP-SF due to time constraints).

*** *p* < .001.

Table 3

Demographic and Clinical Characteristics of Pedophilic PSOCs, Non-pedophilic PSOCs, and Non-offending men

Variable	Non-pedophilic PSOCs			Pedophilic PSOCs			Non-offending men			Analysis		
	<i>M</i>	<i>SD</i>	Range	<i>M</i>	<i>SD</i>	Range	<i>M</i>	<i>SD</i>	Range	Statistic	<i>P</i>	Post-hoc
Age (years) ^a	48.83	9.75	27-65	45.76	12.82	22-62	36.70	10.05	19-64	11.72 ^d	<.001	nPSOCs = pPSOCs nPSOCs > NO ^{***} pPSOCs > NO ^{**}
IQ (NLV) ^b	96.26	10.22	84-124	107.84	10.04	93-130	108.35	4.96	95-118	17.54 ^e	<.001	nPSOCs < pPSOCs ^{**} nPSOCs < NO ^{***} pPSOCs = NO
SRP-SF Tot ^c	61.60	12.95	42-104	62.14	15.74	37-102	49.70	14.03	31-76	7.73 ^d	.001	nPSOCs = pPSOCs nPSOCs > NO ^{**} pPSOCs > NO ^{**}
SRP-SF F1 ^c	29.03	6.89	14-47	29.05	7.55	14-45	25.70	8.31	14-46	2.01 ^d	.141	
SRP-SF F2 ^c	32.57	7.59	19-57	33.10	9.45	21-57	24.00	6.91	15-39	13.05 ^d	<.001	nPSOCs = pPSOCs nPSOCs > NO ^{***}

pPSOCs > NO**

SSPI ^a	1.39	0.90	0-3	3.05	1.16	1-5	n/a	n/a	n/a	36.16 ^d	<.001	n/a
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Note. PSOCs = Persons with a sexual offense against a child; nPSOCs = Non-pedophilic PSOCs; pPSOCs = Pedophilic PSOCs; NO = Non-offending men; NLV = ‘Nederlandse Leestest voor Volwassenen’, Dutch version of the National Adult Reading Test; SRP-SF Tot = Self-Report Psychopathy Short-Form Overall psychopathy score; SRP-SF F1 = Self-Report Psychopathy Short-Form Interpersonal-affective; SRP-SF F2 = Self-Report Psychopathy Short-Form Impulsive-antisocial; SSPI = Screening Scale for Pedophilic Interest; n/a = not applicable.

^a *n* non-pedophilic PSOCs = 36, *n* pedophilic PSOCs = 21, *n* non-offending men = 33. ^b *n* non-pedophilic PSOCs = 31, *n* pedophilic PSOCs = 19, *n* non-offending men = 31 (5 non-pedophilic PSOCs, 2 pedophilic PSOCs, and 2 non-offending men did not complete the NLV due to Dutch not being their native language). ^c *n* non-pedophilic PSOCs = 35, *n* pedophilic PSOCs = 21, *n* non-offending men = 33 (1 non-pedophilic PSOC could not complete the SRP-SF due to time constraints). ^d F ANOVA, Bonferroni corrected post-hoc tests. ^e Welch ANOVA, Games-Howell post-hoc tests.

** $p < .01$. *** $p < .001$.

Table 4

*Pearson Correlations between Demographic / Clinical Characteristics and Outcome**Measures for Pedophilic PSOCs, Non-pedophilic PSOCs, and Non-offending men*

Variable	Commission Errors		Omission Errors	
	<i>r</i>	95% CI	<i>r</i>	95% CI
Age (years) ^a	.24*	[.04, .43]	.21	[.03e-1, .40]
IQ (NLV) ^b	-.26*	[-.45, -.04]	-.26*	[-.45, -.04]
SRP-SF Tot ^c	.17	[-.04, .37]	.05	[-.16, .26]
SRP-SF F1 ^c	.20	[-.01, .39]	-.04	[-.25, .17]
SRP-SF F2 ^c	.11	[-.10, .31]	.11	[-.10, .31]

Note. *r* = Pearson correlation coefficient, CI = confidence interval, NLV = ‘Nederlandse Leestest voor Volwassenen’, Dutch version of the National Adult Reading Test; SRP-SF Tot = Self-Report Psychopathy Short-Form Overall psychopathy score; SRP-SF F1 = Self-Report Psychopathy Short-Form Interpersonal-affective; SRP-SF F2 = Self-Report Psychopathy Short-Form Impulsive-antisocial.

^a *n* = 90. ^b *n* = 81 (5 non-pedophilic PSOCs, 2 pedophilic PSOCs, and 2 non-offending men did not complete the NLV due to Dutch not being their native language). ^c *n* = 89 (1 non-pedophilic PSOC could not complete the SRP-SF due to time constraints).

* *p* < .05.