**Impulsive and compulsive reading comprehension in the prison population**

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**Abstract**

Background: Reading and writing disorders are characteristics of developmental dyslexia and these problems persist into adulthood. Academic failure is strongly correlated with dyslexia, impulsive, compulsive and criminal behaviors.

The aims of this study were to describe impulsive or compulsive reading comprehension in order to determine the differences in errors in reading processes between two groups with Antisocial Personality Disorder (ASPD) and Obsessive-Compulsive Personality Disorder (OCPD) and the relationship with criminal behavior in the prison population.

Methods: We used data from 194 participants: 81 with ASPD and 113 with OCPD from a prison center. Participants took part in interviews to gather data on demographic, criminal and behavioral data, and tests were conducted including the International Examination for Personality Disorders; Symptom Inventory and Battery for the Assessment of Reading Processes in Secondary and High School – Revised.

Results: Differences in reading skills between the ASPD and OCPD groups. Specifically, lower rates of Lexical Selection; Semantic Categorization; Grammar Structures; Grammatical judgements; Expository Comprehension in the OCPD group compared with the ASPD group. We found higher scores on Narrative Comprehension in the OCPD group compared with the ASPD group.

Conclusions: The OCPD group showed slow lexical-phonological coding and slow phonological activation.

**Keywords:** Reading, PROLEC-SE-R, prisoners, compulsivity, impulsivity

**Introduction**

In the prison population, between 48% and 70% are estimated to have reading and writing disorders, with 36% having moderate reading impairments and 50% severe difficulties [1]. Similarly, the results reported [2] indicate that 33% of inmates had serious difficulties with reading and writing. These results have also been found in the youth criminal population, with reported prevalence rates of 50% in reading and writing problems [3]. In particular, it was found that 70% of youths suffered mild disturbances, while 11% showed severe difficulties [4]. Lately, between 28% and 43% of young offenders had severe reading and writing difficulties [5]. Moreover, only 28% of young people who had committed a crime had a reading ability in line with their academic year, whilst 72% read well below their academic year [6]. Even more discouraging is the fact that the prevalence rates of reading and writing disorders in non-incarcerated youths are considerably lower than average (between 5% and 10%). Despite advances in treatment in penitentiary institutions [7], the current prevalence rates of reading and writing difficulties in the prison population are still high, between 15% and 90% [8]. In addition, it was reported that 78% of young prisoners present reading disorders alongside emotional disorders [9]. This considerable diversity in the prevalence of reading and writing difficulties is due to the lack of consensus regarding the definition of dyslexia [10]. Thus, it is a clinical objective to achieve an international standard common language [11].

 Reading deficits constitute the main characteristic of developmental dyslexia and these problems persist into adulthood [12]. In their study, they analyzed whether adults with dyslexia showed reading disorders. Forty participants were divided into two groups, with 20 dyslexic adults (8 males and 12 females) and 20 normal reading adults (8 males and 12 females). All the participants completed the battery of reading processes (PROLEC-SE; [13]) and the participants with dyslexia completed a self-reported test of reading problems. They found that the dyslexia group showed significantly lower scores on all dimensions of the PROLEC battery (Lexical selection; Semantic categorization; Grammatical structures; Grammaticality judgments; Expository comprehension; Narrative comprehension; Word reading; Pseudoword reading; Grammatical structures; Punctuation marks; Pure reading comprehension; Mnemonic reading comprehension and Oral comprehension), compared with the control group. It was concluded that the reading processes are slower and ineffective in people with dyslexia.

In addition, dyslexia is a major obstacle to learning and there are many factors that influence reading. Twenty nine participants were divided into two groups. The first group included nine participants with dyslexia (two female and seven male) and the second group was composed of 20 control participants (12 female and eight male) [14]. They found that children performed worse on the tasks of Lexical Selection, Grammar Structures, Grammatical Judgments, Expository Comprehension, Narrative Comprehension, Word Reading, Pseudoword Reading, Grammar Structures, Punctuation Marks, Pure Reading Comprehension, Mnemonic Reading Comprehension and Oral comprehension, compared with children in the control group. In addition, in terms of semantic categorization, children with dyslexia and younger children in the control group presented worse scores than the older children in the control group. To sum up, the authors suggested that children with dyslexia do not benefit from learning, due to a poorer coding efficiency.

Consequently, learning problems lead to school failure academic failure has a strong correlation with delinquency. In their study, they examined the reading and writing skills (mechanics and expression) of eighty-three incarcerated men who were divided into two groups based on age [15]. Group 1 with 14-15 years old and group 2 with 15-16 years old, with and without difficulties. Their findings revealed a connection between school, community, and juvenile incarceration. They concluded that young incarcerated individuals lack the basic reading and writing skills that are necessary for success in school, employment, and society.

Whilst there are limited studies that have directly evaluated reading skills in the adult prison population, school dropout, low educational level and school failure have shown to be predictive factors of criminal behavior. A relationship between efficacy beliefs and reading and spelling skills (actual skills) has been analysed. Six hundred men from the Norwegian prisons participated in this study [16]. They found a generally low reading and spelling ability, particularly in the youngest participants and those with the longest sentences. Furthermore, high scores on self-efficacy predicted participation in educational activities within the prison. It was concluded that the youngest incarcerated individuals with a diagnosis of dyslexia and those with sentences longer than 5 years need an education plan that is tailored to employment needs.

However, the incorrect functioning of phonological ability is not the only predictor of dyslexia. Sociocultural, educational and emotional problems are highly common in both dyslexia and criminal behaviors [10, 17].

Criminal behaviors are strongly associated with personality and behavioral disorders [18]. In particular, impulsivity and compulsivity are traits that underlie violent behaviors [19]. The American Psychiatric Association [20] defines impulsivity as the execution of unplanned and rapid actions carried out without considering the possible negative consequences. Compulsivity has been defined as the appearance of recurrent behaviors whose goal is to reduce or avoid anxiety or distress [20]. Furthermore, compulsive maladaptive behavior has been classified as something planned, conscious, and never as a spontaneous act [21].

Dyslexia could be defined as poor phonological-processing skills affecting word decoding and the ability to decode fluently and to recognize single words, refers to a neurodevelopmental disorder with a biological origin causing [22]. In this study, we make use of the well-documented finding that dyslexia and compulsivity share common underlying biological bases. Compulsive behavior is associated with increased frontal lobe activity, whereas impulsive behavior is associated with reduced frontal lobe activity [23]. Increased frontal lobe activity can characterize compulsive disorders, such as obsessive compulsive disorder (OCD). Conversely, decreased frontal lobe activity can characterize impulsive disorders, such as substance use and antisocial personality disorder (SUD and APT). Numerous studies [24, 25] provide evidence to support the association between impulsivity and substance use disorders (SSD) and violent or aggressive behavior. In contrast, research on compulsivity has been scarce, to date compulsivity has only been analyzed since the discovery of OCD [21] and few studies have analyzed its role in relation to addictive behaviors [26].

The biological bases of compulsivity share multiple brain areas and neural circuits with language and communication. Numerous studies [27, 28] on the biological bases of compulsivity have identified five main brain structures: 1) dorsolateral prefrontal cortex, lateral orbitofrontal cortex and the caudate nucleus, which form the reverse learning circuit; 2) supplementary motor area, premotor cortex and putamen, which form the habit learning circuit; 3) cortical-striatum-thalamic-cortical circuits; 4) fronto-limbic connection and 5) anterior cingulate nucleus. These areas have been extensively studied and linked to a wide range of language functions. More recent studies [29, 30] have found a strong association between each of the structures described above and various language functions.

The arcuate and superior longitudinal fascicles form the dorsal, sub-lexical, or phonological pathway of language. Conversely, the uncinate, inferior longitudinal and fronto-occipital fascicles constitute the ventral, lexical or semantic route of language. Both routes are specialized in interconnecting distant language areas, creating networks in charge of phonological recognition and language interpretation [12, 14, 29, 31].

Lesions or abnormalities in four fascicles have been studied [1) the arcuate fascicle, 2) the uncinate fascicle, 3) the longitudinal fascicle and 4) the fronto-occipital fascicle], which connect with compulsivity areas, leading to alterations in language, such as phonological and word repetition, verbal short-term memory tasks, articulation and also disruption in the capacity to discriminate between phonemes [29]. The arcuate fascicle is composed of neuronal fibers that connect frontal, temporal and parietal areas [32]. The uncinate fascicle extends from the lower frontal lobe, the fronto-orbicular area, to the temporal lobe, sending fibers to subcortical structures such as the hippocampus and the amygdala. The longitudinal fascicle can be separated into three segments which are superior, medium and inferior; the lower segment arises from the frontal and prefrontal lobe to connect with the occipital lobe, releasing fibers directly towards the posterior region of the parietal and temporal areas of the paleocortex and the insula. The upper segment connects the temporal area with the motor and premotor areas, passing through the angular and supramarginal gyrus [29]. The fronto-occipital fascicle shares the same pathway as the inferior longitudinal fascicle [33].

Given the practical importance of understanding how the reading abilities in the prison population may impact criminal behavior, the aim of this study was to describe impulsive or compulsive reading comprehension (using PROLEC-SE-R). Due to nowadays there are not research about reading processes between OCPD and ASPD. Therefore, the main reasons for developing this study are: First, Antisocial Personality Disorder (ASPD) prevalence rates are identified between 30% to 60% in male prisoners and over 63% Obsessive Compulsive Personality Disorders (OCPD) [34-36]. Second, ASPD and OCPD could share violent or aggressive behavior [24, 25, 37]. Increased frontal lobe activity may characterize compulsive disorders, such as obsessive-compulsive disorder (OCPD). In contrast, decreased frontal lobe activity may characterize impulsive disorders, such as antisocial personality disorder (ASPD) and third, the biological bases of compulsivity share multiple brain areas and neural circuits with language and communication [38]. In particular, our aim was to determine the differences in errors in reading processes between two groups, one with Antisocial Personality Disorder (ASPD) and another with Obsessive Compulsive Personality Disorder (OCPD), and to explore the relationship between these measures and criminal behavior in the prison population.

**Methodology**

**Participants**

This study included 194 men (mean age = 37.08, SD = 8.81, range = 18 to 55 years) from the Albolote Penitentiary in Granada, Spain. Of the sample, 81 had been diagnosed with ASPD and 112 with OCPD. The participants were divided into two groups. Group 1 had Antisocial Personality Disorder (ASPD) and included 81 men (mean age = 36.86, SD = 9.32). Group 2 had Obsessive Compulsive Personality Disorder and consisted of 113 men (mean age = 38.78, SD = 8.47). Participants were screened using the International Personality Disorder Exam (IPDE; [39]). The inclusion criteria were as follows: to be aged between 18 and 55 years old, and suffering from ASPD or OCPD. Participants were excluded according to the following exclusion criteria: being older than 55 years, having a physical illness, psychiatric illness (schizophrenia or depression) or currently undergoing psychopharmacological treatment.

**Procedure**

The participants were interviewed individually to confirm whether they met the inclusion criteria and were then offered the opportunity to participate in the research. Afterwards, they completed the International Review for Personality Disorders [IPDE; (39)] and participants with Antisocial Personality Disorder (ASPD) and Obsessive Compulsive Personality Disorder (OCPD) were selected. They took part in an individual session in which they completed the measures indicated below. At the beginning of the session, participants were reminded of their rights to abandon the study at any moment and provided written informed consent if they agreed to participate. At the end of the session, participants were debriefed and thanked for their participation. The participants signed the informed consent form and the prison staff (psychologist and educator) collected the relevant sociodemographic data. This research study has been approved by the Ethics Committee of the Junta de Andalucia.

**Measures**

We employed the following measures:

*Demographic, Crime, and Institutional Behavior Interview.* The interview was designed specifically for this project and consisted of questions designed to obtain socio-demographic data, information regarding the types of crimes committed, and any punishment or prison sentences received according to the Spanish prison regulation law (Real Decreto 1201/1981, 8 de Mayo, Artículos 107 y 108).

*International Personality Disorder Exam* (IPDE; [39, 40]). This is a diagnostic instrument based on a semi-structured clinical interview, designed according to DSM-5 criteria [20]. The items consist of open questions, multiple-choice questions, and yes/no questions. The items are classified according to the following six categories: work, self, interpersonal relations, affects, reality check, and impulse control. In addition, the IPDE includes a screening questionnaire that reduces the interview administration time by identifying the personality disorders that the person is unlikely to suffer and excluding further questions regarding these disorders. Completion of the IPDE takes between 60 and 90 minutes and must be administered by trained and experienced professionals. The reliability and stability indices obtained for the IPDE vary between .70 and .96 [39]. This instrument is considered to be one of the most useful and valid tools for assessing personality disorders for research purposes [39, 40].

*The Symptom Checklist-90-R* (SCL-90-R; [41]). This is a symptom scale that evaluates the degree of psychological distress a person has experienced in the past week. It consists of 90 items using Likert scales with five response options. The instrument is structured according to nine primary dimensions: Somatizations (SOM), Obsessions and compulsions (OBS), Interpersonal sensitivity (IS), Depression (DEP), Anxiety (ANS), Hostility (HOS), Phobic anxiety (PHO), Paranoid ideation (PAR), and Psychoticism (PSIC). There are seven additional items targeting sleep disorders, eating disorders, death-related thoughts, and feelings of guilt. Three global indices of distress are derived from the scores: An Index of Global Severity (IGS) indicating current levels of perceived distress, Total Positive Symptoms (TPS) indicating the total number of present positive symptoms, and the Index of Symptomatic Distress (ISD) evaluating the response style towards symptoms. Reliability studies show that the nine dimensions reach values close to or larger than α=.70 and the concurrent and predictive validity of the inventory and its subscales have been demonstrated using as criteria other clinical evaluation instruments, screening scales, psychiatric diagnoses, structured evaluation protocols, or recidivism indicators [39]. We used the Spanish adaptation of the inventory [42].

*Battery for the Assessment of Reading Processes in Secondary and High School - Revised (PROLEC-SE-R; [43]).*To assess the main reading processes, the PROLEC-SE-R test was used to evaluate lexical, syntactic and semantic processes. Moreover, this test analyzes and detects reading difficulties such as dyslexia and hyperlexia. It consists of thirteen tasks [43]. In this study, the six-task screening version was applied, which included Lexical Selection (50 items; participants decide whether or not the presented words are real; time limited task according to test instructions); Semantic Categorization (90 items; participants determined whether or not the displayed words were an animal; time limited task according to the instructions); Grammatical Structures I (24 items; the aim was to verify which sentences correctly described what the images represented; time limited task according to the instructions); Grammatical Judgments (35 items; participants decided whether or not the presented phrases were grammatically correct; time limited task according to the test instructions); Expository Comprehension (this consisted of reading an expository text and completing ten multiple choice questions with four response alternatives, only one of which was correct; time limited task according to the instructions); Narrative Comprehension (participants read a text and answered 10 multiple-choice items about the content of the text; answers could be identified by consulting the text; there was no time limit for reading the text and answering the questions). The Cronbach's alpha reliability index reported for the norm of this test is .79.

*Ethical Considerations*

The Ethics Committee of the Junta de Andalucia approved the study (approval number PEIBA:0766-N-21). Participation was voluntary and anonymous, and all participants were informed about the purpose, methods, and course of the study and their right to refuse or discontinue participation. Written informed consent was obtained from each participant before inclusion, and the research complied with the principles proposed by the Declaration of Helsinki.

**Results**

**Descriptive Statistics**

Descriptive statistics are presented in Table 1 and show the sociodemographic variables and those related to drug abuse, alcoholism history, alcohol and drug treatment and crimes according to group (ASPD and OCPD). To examine the differences between the groups in terms of sociodemographic variables (marital status and educational level), alcohol and drug abuse treatment, and crime, regression analyses were conducted from contingency tables, calculating the chi square statistic for the variables analyzed. The OCPD group contained a higher number of married men than the ASPD group, the number of drug and alcohol abusers was higher in the OCPD group than the ASPD group, whilst the OCPD group had a higher number of participants who had received treatment to quit drugs and alcohol compared with the ASPD group. There were no significant differences in crimes between the groups (ASPD and OCPD). However, members of the OCPD group had been involved in more cases of gender violence, both as the main crime and as a secondary crime.

**Psychological distress results**

To examine differences in psychological distress between groups we conducted a Multivariate Analysis of Variance (MANCOVA) for a unifactorial design between groups, using Somatizations (SOM), Obsessions and compulsions (OBS), Interpersonal sensitivity (IS), Depression (DEP), Anxiety (ANS), Hostility (HOS), Phobic anxiety (PHO), Paranoid ideation (PAR), Psychoticism (PSIC), Index of Global Severity (IGS), Total Positive Symptoms (TPS) and Index of Symptomatic Distress (PSD) as dependent variables and group (ASPD and OCPD) as the independent variable. It is clear from Table 2 that the OCPD group showed lower scores on hostility than the ASPD group.

**PROLEC-SE-R results**

To explore differences between groups we proceeded to analyze the reading processes measured using the PROLEC-SE-R. Multivariate Analysis of Covariance (MANCOVA) was conducted using a between-group unifactorial design using educational level as a covariate, group (ASPD and OCPD) as the independent variable and the PROLEC-SE-R scores (Lexical Selection, Semantic Categorization, Grammatical Structures I, Grammatical Judgments, Expository Comprehension, Narrative Comprehension) as dependent variables. The results revealed statistically significant differences between the groups (Wilks' Lambda = .557, F6,186 = 24.704; p<.001).

Since the MANCOVA showed statistically significant main effects, univariate ANCOVAs were calculated for each level of the dependent variable (Lexical Selection, Semantic Categorization, Grammar Structures I, Grammaticality Judgments, Expository Comprehension, Narrative Comprehension). The ANCOVAs revealed statistically significant differences in Lexical Selection (F2,191 = 23.22; Mce = 34.844; p<.001), these scores being higher in ASPD than OCPD; in Semantic Categorization (F2,191 = 8.22; Mce = 10.71; p<.001) with the ASPD group showing a higher score than the OCPD group; in Grammar Structures I (F2,191 = 17.55; Mce = 20.07; p<.001) with the ASPD group scoring higher than the OCPD group; in Grammatical Judgments (F2,191 = 11.09; Mce = 12.167; p<.001) with the ASPD group obtaining lower scores than the OCPD group; in Expository Comprehension (F2,191 = 7.26; Mce = 10.187; p<.001) with the ASPD group showing higher scores than the OCPD group; and in Narrative Comprehension (F2,191 = 9.95; Mce = 7.249; p<.001) with the ASPD group showing poorer performance than the OCPD group (See Table 3).

**Discussion**

This study set out to explore the differences in errors in reading processes between two groups, one diagnosed with Antisocial Personality Disorder (ASPD) and another with Obsessive Compulsive Personality Disorder (OCPD), along with the relationship between these measures and criminal behavior in the prison population. In spite of the positive interest shown in developing treatments in the prison population, more research still needs to be done to improve speech and language abilities.

Whilst ASPD has been more extensively studied and has been the subject of numerous investigations, OCPD has been relatively under-explored. Individuals with OCPD are more likely to eventually seek treatment since this is considered a very debilitating disorder that, due to the numerous obsessions and/or compulsions associated with it, has a strong impact on the quality of life of the patient [44, 45]. OCPD, however, has been mistakenly considered a less serious and tangible disorder over the years, and therefore somewhat less studied. As a result of this fact, the current DSM-5 [20] shows the considerable difference between the two disorders in terms of the information that is currently available.

Regarding the sociodemographic differences between these disorders, there appear to be no significant differences between the two groups. The number of married men in the OCPD group was higher than that of the ASPD group, a difference that could already be indicative of a specific profile.

Participants in the OCPD group consumed less alcohol and drugs than those of the ASPD group, whilst more members of the OCPD group sought treatment to quit drugs or alcohol. This could be due to a previously mentioned characteristic of OCPD, that is, the need to have control.

There were no significant differences in crimes between the groups (ASPD and OCPD) However, focusing on the cases of gender violence, the OCPD group were involved in more cases of gender violence — both as the main crime and as the secondary crime. This is a fact that is particularly striking since, as the DSM-5 [20] points out, OCPD sufferers have a tendency to get upset or angry in situations in which they are not able to maintain control of their physical or interpersonal environment; however, anger is not usually expressed directly.

There were no significant differences between the groups in terms of the measures of psychological distress, except for hostility, where the ASPD group obtained a higher score than the OCPD group. In general, ASPD patients present a lack of empathy, tend to be cynical, cruel, and despise the feelings and sufferings of others, and thus these symptoms are specific to these disorders [44, 46].

Our findings indicate differences in reading skills between the ASPD and OCPD groups. First, the results showed significantly lower rates of Lexical Selection from PROLEC-SE-R in the OCPD group compared with the ASPD group. This suggests that compulsives have a greater difficulty in identifying words or pseudowords (with fewer test items answered), or reading new or infrequent words. These difficulties are related to phonological processing, phonological integration, working memory and the visual system and are congruent with the findings reported by several studies [10, 14, 47] that claim that slow reading is a reflection of slow lexical phonological coding. Then, it could be concluded that there is a disruption in the functional features of the supplementary motor area, the premotor cortex and the putamen, as well as in the anterior cingulate nucleus, the cortico-striatum-thalamic-cortical circuits and the fronto-limbic connections, in addition to the fascicles of the dorsal or sub-lexical route [12, 14, 21, 48, 49].

Second, lower rates of Semantic Categorization from PROLEC-SE-R have been found in the OCPD group compared with the ASPD group. This indicates that compulsives present greater difficulty in the selection of words and pseudowords. These difficulties are associated with semantic categorization, the visual system, phonological and semantic fluency, phonological and syntactic processing, semantic integration and working memory. According to other findings [12, 14, 28, 48-50], this could reflect a disruption in the functional features of the dorsolateral prefrontal cortex, the lateral orbito-frontal cortex, the caudate nucleus, as well as the anterior cingulate nucleus, the cortico-striatum-thalamic-cortical circuits and the fronto-limbic system.

Third, lower scores on Grammar Structures from the PROLEC-SE-R have been identified in the OCPD group compared with the ASPD group. This shows that compulsives present greater difficulties in syntax, verbal fluency, generation of phrases and verbs, phonological and semantic processing, word retrieval, semantic integration, working memory, generation and control of language, selective attention, and information processing. This could be taken to indicate possible alterations in the dorsolateral prefrontal cortex, the lateral orbito-frontal cortex, the caudate nucleus, in addition to the supplementary motor area, the premotor cortex and the putamen, as well as the anterior cingulate nucleus, the cortico-striatum-thalamic-cortical circuits and fronto-limbic connections with the fascicles of the dorsal route (as mentioned previously) and ventral route [12, 14,15, 28, 50]. The ventral or lexical route is linked to reading processes (known and frequent words) and object recognition. Lesions to this route may cause phonetic paraphasia, semantic paraphasia, interruption or arrest of language and syntax errors [12, 29, 31].

 Fourth, lower scores on Grammatical judgements from PROLEC-SE-R have been noted in the OCPD group compared with the ASPD group. This indicates that compulsives present greater difficulties in syntax, verbal fluency, generation of phrases and verbs, phonological and semantic processing, word retrieval, semantic integration, working memory, generation and control of language, selective attention, and information processing. This could indicate possible alterations in the dorsolateral prefrontal cortex, the lateral orbitofrontal cortex, the caudate nucleus, in addition to the supplementary motor area, the premotor cortex and the putamen, as well as in the anterior cingulate nucleus, the cortico-striatum-thalamic-cortical circuits and fronto-limbic connections, along with the fascicles of lexical and sub-lexical routes [12, 14, 15, 28, 50].

 Fifth, lower rates of Expository Comprehension from the PROLEC-SE-R have been noted in the OCPD group compared with the ASPD group. This points to the possibility that compulsives present greater difficulties in reading comprehension such as syntax, verbal fluency, phonological and semantic processing, semantic integration, working memory, the generation and control of language, selective attention and information processing. This could imply possible alterations in the dorsolateral prefrontal cortex, in the lateral orbitofrontal cortex, in the caudate nucleus, in addition to the supplementary motor area, the premotor cortex and the putamen, as well as in the anterior cingulate nucleus, the cortico-striatum-thalamic-cortical circuits and fronto-limbic connections and the fascicles of lexical and sub-lexical routes [12, 14, 28, 48, 49, 51].

 Sixth, we found higher scores on Narrative Comprehension from the PROLEC-SE-R in the OCPD group compared with the ASPD group. This finding could be due to the idiosyncrasy of each type of personality disorder. Whist the OCPD group do not see time as a distracting element, they focus their efforts on trying to perform tasks correctly, forgetting about time and, therefore, obtain better results even if they respond to fewer items. In contrast, the ASPD group could suffer from the effects of fatigue or tiredness when trying to finish quickly and correctly (it is important to note that this task is not timed). This would involve possible alterations in the dorsolateral prefrontal cortex, the lateral orbitofrontal cortex, the caudate nucleus, in addition to the supplementary motor area, the premotor cortex and the putamen, as well as the anterior cingulate nucleus, the cortico-striatum-thalamic-cortical circuits and fronto-limbic connections, along with the fascicles of lexical and sub-lexical routes [12, 14, 28, 50].

Generally, OCPD is characterized by slow lexical-phonological coding and slow phonological activation. This is a problem of reading speed rather than accuracy. These results are consistent with those reported by other authors [9, 14] which compared different languages ​​and found problems in reading speed between transparent languages, such as Spanish. In opaque languages, like English, the opposite occurs, that is, the problem appears to be one of accuracy rather than speed.

Moreover, we found that phonological decoding problems and impaired reading comprehension represent the main disadvantages for reading in people with OCPD, who develop symptoms similar to dyslexia, as demonstrated previously [9] where it was found that poor word recognition, poor vocabulary, poor syntactic ability, along with other cognitive and motivational processes, could explain the dyslexia observed among the prisoners studied. Problems in acquiring a correct reading speed and the automation of this speed should be considered fundamental elements for the development of interventions aimed at the prison population. Findings from a number of studies [4, 5, 47, 52, 53] suggest that reduced reading speed is associated with a deficit in phonological processing. However, although this relationship is well-documented, the intervention must address both aspects separately. Our study has shown that participants with compulsive behavior were slower and inaccurate readers.

 The OCPD language deficits found in this study that have been described by other authors [14, 49] as symptoms of dyslexia is a finding of great interest. The process that begins with a reading problem and ends in incarceration involves not only emotional and social costs for the lives of the prisoners, but also entails an economic cost to the judicial system of each country. According to previous studies [7], this school-criminal sequence should receive specialist attention to alleviate the reading problems of the prison population.

 We agree with previous studies [17, 52] which declared that appropriate treatments in minor centers can improve reading skills and encourage the minors to continue to improve, increasing their job opportunities. In addition, some studies [15, 16] suggest that young prisoners who participate in intervention programs have greater opportunities for employment and job placement, and also show lower rates of recidivism. Thus, there is a strong correlation between participation in prison education and a reduction in criminal recidivism. Therefore, the longer the sentence, the greater the need to plan vocation-based educational programs for prisoners.

As with all research, our results should be evaluated in the context of several limitations. For instance, the linguistic disorders studied in the present work require further analysis of the cognitive processes involved in language such as learning, attention, working memory and executive functions. Further, our sample included only males. Our research was based on the study of only men for the following three reasons: first, we have considered crimes such as gender abuse, which is understood to involve the aggression of men towards women; second, there were no women who were serving a prison sentence for partner violence; and third, the prison population contains five times more men than women, and thus, given our inclusion and exclusion criteria it would have been impossible to conduct this study in women. It would also have been desirable to compare our groups with control and dyslexia groups. Finally we have not considered evaluating whether our sample (ASPD and OCPD) would have Attention Deficits and Hyperactivity Disorder (ADHD), dyslexia or other learning disabilities, then it would be considered in future research. Nevertheless, this is the first study to examine reading disorders in prison populations with compulsive behaviour (OCPD) and impulsive behaviour (ASPD). Likewise, there are very few studies that analyze performance on the separate components of the PROLEC-SE-R.

**Conclusion**

OCPD is characterized by slow lexical-phonological coding and slow phonological activation. Specifically, our OCPD group obtained lower scores on Lexical Selection, Semantic Categorization, Grammatical Structures I, and Expository Comprehension than the ASPD group. However, the OCPD group obtained higher scores on Grammatical Judgments and Narrative Comprehension.

**Ethics approval and consent to participate**

This study was approved by the Research Ethics Committee of Junta de Andalucía (approval number PEIBA: 0766-N-21). All procedures carried out in our study involving human participants followed the ethical standards of the institutional research committee and the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

**Consent for publication**

Not applicable

**Competing interests**

The authors declare no conflict of interests.

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**Availability of Data and Materials**

R codes and data are available from the authors on request.

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**Table 1: Sociodemographic variables and those related to drug abuse, alcoholism history, alcohol and drug treatment and crimes according to group**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **ASPD**  | **OCPD** | 2 |
| **Marital Status (N)** |  |  | **10,916\*\*** |
| Single  | 41 | 48 |
| Married | 10 | 35 |
| Divorced | 12 | 15 |
| Widower | 1 | 0 |
| Convive with couple  | 17 | 15 |
| **Educational Level (N)** |  |  | 1,575 |
| Non-elementary | 17 | 16 |
| Elementary  | 33 | 51 |
| Secondary | 21 | 31 |
| High School | 8 | 12 |
| Degree  | 2 | 3 |
| **Crime 1 (N)** |  |  | 3,417 |
| Against life and integrity | 10 | 13 |
| Against Freedom | 4 | 7 |
| Against Property; Public estate | 46 | 52 |
| Against Public Health | 8 | 20 |
| Gender Violence | 13 | 21 |
| **Crime 2(N)** |  |  | 8,416 |
| No crime | 19 | 34 |
| Against life and integrity | 15 | 10 |
| Against Freedom | 1 | 6 |
| Against Property; Public estate | 34 | 40 |
| Against Public Health | 10 | 16 |
| Gender Violence | 2 | 7 |
| **Alcohol and Drug Abuse History (N)** |  |  | **10,487\*\*** |
| No Consume | 11 | 33 |
| Drug Abuse  | 37 | 42 |
| Alcohol  | 4 | 12 |
| Alcohol and drug abuse  | 29 | 26 |
| **Drug Abuse (N)** |  |  | **25,370\*\*\*** |
| Never | 14 | 54 |
| Sometimes  | 33 | 39 |
| Frequently  | 22 | 9 |
| Always | 6 | 7 |
| Very much | 6 | 4 |
| **Alcohol Abuse (N)** |  |  | **8,216\*** |
| Never | 22 | 37 |
| Sometimes  | 40 | 61 |
| Frequently  | 9 | 9 |
| Always | 5 | 6 |
| Very much | 5 | 0 |
| **Alcohol and Drug Treatment History (N)** |  |  | **9,965\*\*** |
| Never | 18 | 45 |  |
| Currently in Prison  | 34 | 32 |  |
| Throughout life in Prison  | 21 | 19 |  |
| Outside of Prison  | 8 | 17 |  |

*Note*: \*\*\**p*< .001; \*\**p*< .01; \**p*< .05

**Table 2: Mean, standard deviation, significance level and statistical power of The Symptom Checklist (SCL-90-R)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **SCL-90-R** | **ASPD** Mean (SD) | **OCPD**Mean (SD) | Range of Scores | *F* |  |
| Total SCL-90 | 40.34 (2.63) | 38.12 (19. 11) | 5-87 | .596 | .003 |
| Total Positive Symptoms  | 52.83 (23.85) | 49.20 (23.01) | 5-97 | 1.141 | .006 |
| Index Symptomatic Distress | 25.99 (18.87) | 27.08 (19.60) | 5-85 | .151 | .001 |
| Somatizations | 37.59 (23.98) | 40.86 (25.06) | 5-97 | .831 | .004 |
| Obsessions and compulsions | 44.69 (21.25) | 42. 88 (21.52) | 5-95 | .339 | .002 |
| Interpersonal sensitivity  | 42.65 (22.45) | 42.96 (2.28) | 5-87 | .010 | .000 |
| Depression  | 41.57 (2.00) | 43.54 (19.19) | 5-90 | .478 | .002 |
| Anxiety  | 40. 03 (2.73) | 35.42 (2.10) | 5-90 | 2.418 | .012 |
| Hostility  | 51. 67 (2.26) | 37. 34 (14.22) | 15-85 | 33.475\*\*\* | .148 |
| Phobic anxiety  | 40.18 (15.49) | 42. 46 (16.82) | 20-90 | .918 | .005 |
| Paranoid Ideation  | 55. 34 (17. 60) | 54. 33 (18. 18) | 5-97 | .149 | .001 |
| Psychoticism  | 47. 78 (15. 44) | 45. 15 (16. 51) | 5-95 | 1.257 | .007 |

*Note*: \*\*\**p*< .001; ns= not significant

**Table 3**. **Mean, standard deviation, significance level and statistical power of reading (PROLEC-SE-R) according to group**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **PROLEC-SE-R** | **ASPD** **Mean (SD)** | **OCPD** **Mean (SD)** | **Range of Scores** | **F** | **η** |
| Lexical Selection | 3.05 (1.33) | 2.76 (1.37) | 1-5 | 23.223\*\*\* | .196 |
| Semantic Categorization  | 2.66 (1.19) | 2.34 (1.17) | 1-5 | 8. 222\*\*\* | .079 |
| Grammatical Structures I | 2.26 (1.12) | 2.25 (1.92) | 1-5 | 17.545\*\*\* | .155 |
| Grammatical Judgments  | 1.89 (1.14) | 1.90 (1.08) | 1-5 | 11.087\*\*\* | .104 |
| Expository Comprehension | 2.95 (1.24) | 2.81 (1.21) | 1-5 | 7. 256\*\*\* | .071 |
| Narrative Comprehension | 3.35 (0.88) | 3.50 (0.90) | 1-5 | 9. 952\*\*\* | .094 |

*Note*: \*\*\**p*< .001; *Note*: \*\*\**p*< .001