Title: **Memory and linguistic/executive functions of children with Borderline Intellectual Functioning**

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Abstract

Children with Borderline Intellectual Functioning (BIF) have received little research attention and have been studied in conjunction with Intellectual and Developmental Disabilities. The present study intends to broaden the knowledge on BIF, by analyzing domains such as verbal memory and visual memory, as well as tasks that rely simultaneously on memory, executive functions and language. A cross-sectional, comparison study was carried out between a group of 40 children with BIF (mean age = 10.03; 24 male and 16 female), and a control group of 40 normal children of the same age, gender and socioeconomic level as the BIF group. The WISC-III Full Scale IQs of the BIF group ranged from 71 to 84. The following instruments were used: Word List, Narrative Memory, Rey Complex Figure, Face Memory, Rapid Naming (both RAN and RAS tests) and Verbal Fluency. The results showed deficits in children with BIF in verbal short-term memory, rapid naming, phonemic verbal fluency and visual short-term memory, specifically in a visual recognition task, when compared with the control group. Long-term verbal memory was impaired only in older children with BIF and long-term visual memory showed no deficit. Verbal short term memory stands out as a limitation and visual long term memory as a strength. Correlations between the WISC-III and neuropsychological tests scores were predominantly low. The study expands the neuropsychological characterization of children with BIF and the implications of the deficits and strengths are stressed.

Keywords: Borderline Intellectual Functioning, neuropsychological functions, verbal memory, visual memory, rapid naming, verbal fluency

Introduction

Borderline Intellectual Functioning (BIF), or borderline intelligence (Jankowska, Bogdanowicz, & Takagi, 2014), is a clinical entity that has been scarcely studied (Fernell & Ek, 2010; Salvador-Carulla et al., 2013). It is conceptualized as the border that separates an individual's "normal" intellectual functioning and the Intellectual and Developmental Disabilities (IDDs) (Salvador-Carulla et al., 2013). It describes a below-average intelligence level, with intelligence test scores between -1.01 and -2.00 standard deviations indicating, therefore, that on an intelligence scale with a mean of 100 and a standard deviation of 15, the BIF corresponds to an Intelligence Quotient (IQ) between 70 and 84 on the Full Scale (Jankowska et al., 2014; Salvador-Carulla et al., 2013).

In the literature, individuals with BIF, and the BIF itself, are referred to under the terms Slow Learners, Borderline Intellectual Functioning, Sub-average Intellectual Functioning, Borderline Mental Retardation, Borderline Intellectual Capacity and/or Borderline Learning Disability (Salvador-Carulla et al., 2013). In the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association [APA], 2013), the designation Borderline Intellectual Functioning is used and is part of "other conditions that may be a focus of clinical attention", or that may otherwise affect the diagnosis, course, prognosis or treatment. The lack of consistency in the terminology adopted is one of the factors contributing to the difficulty in determining the prevalence of BIF among the general population. However, based on the normal distribution curve, approximately 14% of the population presents BIF (Jankowska et al., 2014; Kaznowski, 2004; Salvador-Carulla et al., 2013).

Most neuropsychological studies with children and adolescents with BIF have focused on verbal short-term memory and working memory (Alloway, 2010; Hasselhorn & Mähler, 2007; Henry, 2001; Maehler & Schuchardt, 2009; Schuchardt, Gebhardt, & Mäehler, 2010;

Van der Molen, Van Luit, Jongmans, & Van der Molen, 2007, 2009; Van der Molen, Henry, & Van Luit, 2014), and at the same time the samples of these studies included both BIF and mild IDDs (Hasselhorn & Mähler, 2007; Henry, 2001; Maehler & Schuchardt, 2009; Schuchardt et al., 2010; Van der Molen et al., 2007, 2009, 2014). There is also a study that, concurrently, focused on BIF, mild and moderate IDDs (Henry, 2001), whereas only one study has exclusively addressed children with BIF (Alloway, 2010). The groups that simultaneously combine the BIF and the IDDs are usually called Mild Intellectual Disabilities (MIDs).

Empirical evidence shows consistency concerning a short-term verbal memory deficit of groups that include BIF, both when compared with a control group of the same mental age (Schuchardt et al., 2010) and when compared with a control group of the same chronological age (Alloway, 2010; Henry, 2001; Maehler & Schuchardt, 2009; Van der Molen et al., 2009). As regards the sub-vocal rehearsal process, the results are inconsistent: on the one hand, the study by Hasselhorn and Mähler (2007) showed a deficit when MIDs were compared to the control group of the same mental age; on the other hand, the study by Van der Molen et al. (2007) revealed an intact automatic repetition when MIDs were compared to the equivalent chronological age control group and minimal differences when compared to the control group of the same mental age. Poloczek et al. (2016) also reported that verbal strategy use was not impaired in adolescents with MIDs and was mental age appropriate.

In addition, there is broad agreement regarding a deficit in verbal working memory of groups that include BIF, both by reference to the control group equivalent in chronological age (Alloway, 2010; Maehler & Schuchardt, 2009; Schuchardt et al., 2010), and by comparison with the control group with equivalent mental age (Van der Molen et al., 2009), with the deficit being even more pronounced in the latter case. However, an exception was seen in the study carried out by Henry (2001): although children with BIF had displayed a deficit in the performance of the Digit Span Backward, they did not present any problem when performing the Listening Span Task compared with the control group of the same chronological age.

In the context of BIF verbal memory, it is noted that long-term memory has been neglected both when considered alone and when considered in comparison with short-term memory. It is also worth noting that the latter has been analyzed through memory tests or tasks of digits (e.g., Van der Molen, 2007, 2009), of words (e. g., Hasselhorn & Mähler, 2007), of pseudowords (e.g., Henry, 2001) or all of these stimuli (e. g., Alloway, 2010), yet tasks such as storytelling have been neglected.

With regard to short-term visuo-spatial memory and visuo-spatial working memory, the results are also inconsistent. Despite the fact that in the majority of the studies children with BIF had presented a poorer performance when compared with the control group of equivalent chronological age (Alloway, 2010; Maehler e Schuchardt, 2009; Schuchardt et al., 2010; Van der Molen et al., 2009), in the study by Henry (2001), they showed a performance as good as the mentioned reference group.

As pointed out in relation to verbal memory, it is noted that BIF long-term visual memory has been neglected, either alone or in conjunction with short-term visual memory. There is also a lack of studies on face memory, which has a slow developmental trajectory (Croydon, Pimperton, Ewing, Duchaine, & Pelicano, 2014) and is sensitive to individual differences, including those related to intelligence (Gignac, Shankaralingam, Walker, & Kilpatrick, 2016).

Besides memory, subdomains of the executive functions were also addressed in groups with BIF or MIDs: inhibition of response (Alloway, 2010; Van der Molen et al., 2007, 2014; Van der Molen, Van Luit, Van der Molen, Klugkist, & Jongmans, 2010); set shifting (Alloway, 2010); planning (Alloway, 2010; Van der Molen et al., 2007); verbal fluency (Van der Molen et al., 2007); and attention control (Bexkens, Van der Molen, Collot d'Escury-Koenigs, & Huizenga, 2014; Van der Molen et al., 2007). The empirical data showed that in relation to chronological age, children with BIF or MIDs presented deficits: in planning (Alloway, 2010; Van der Molen et al., 2007); in set shifting (Alloway, 2010); in semantic and phonemic verbal fluency (the deficits are even more pronounced than those of the control group with equivalent mental age; Van der Molen et al., 2007); and in interference control (Bexkens et al., 2014). Concerning the inhibitory control, there are contradictory data, since problems have been demonstrated in the response inhibition ability of children with BIF (Alloway, 2010) and of young people with MIDs (Van der Molen et al., 2007). However, the latter authors detected deficits between individuals with MIDs and individuals of the same chronological age, when some results were considered alone, but not when a factor that included several indicators of inhibition was taken into account.

Objectives

The general consensus of the authors who have studied children with BIF is that they have received little scientific, legislative or educational attention (e. g., Bonifacci & Snowling, 2008; Fernell & Ek, 2010; Kaznowski, 2004).

Moreover, and with one exception (Alloway, 2010), researchers have studied BIF in conjunction with the mild IDDs, integrating them into the same group (e. g., Bexkens et al., 2014; Bonifacci & Snowling, 2008; Hasselhorn & Mähler, 2007; Maehler & Schuchardt, 2009; Van der Molen et al., 2007, 2009). Thus, in general individuals with a broad IQs range are analyzed (from 50/55 to 85/88) and the effective number of individuals with BIF is either reduced [e. g., 10 (Henry, 2001), 17 (Bonifacci & Snowling, 2008)] or not specified (Maehler & Schuchardt, 2009; Poloczek et al., 2016; Van der Molen et al., 2007, 2009). Nevertheless, there is evidence that BIF and mild IDDs are different (Henry, 2001; Schuchardt et al., 2010; Van der Molen et al., 2009, 2014), and therefore should not be studied in the same group. For example, Henry (2001) found that children with mild IDDs had deficits in all memory tasks, whereas children with BIF performed as well as the control group of the same chronological age in tasks related to visuo-spatial short-term and working memory. In turn, Schuchardt et al. (2010) and Van der Molen et al. (2014) found that children and young people with BIF performed better on short-term visuo-spatial memory and visuo-spatial working memory tasks than children and young people with mild IDDs. To sum up, integrating individuals with very different IQs in a single group does not express the specificity of their cognitive skills (Van der Molen et al., 2009) and emphasizes the importance of analyzing more circumscribed groups.

Thus, the present study intends to carry on and expand the neuropsychological characterization of children and adolescents with borderline intelligence, focusing exclusively on them, and in particular, evaluating domains other than those addressed in the reviewed studies. Firstly, this research objective is to analyze and compare the short- and long-term verbal and visual memory of children and adolescents with BIF by reference to a control group of the same chronological age. Based on the available literature, deficits are predicted only in short-term verbal and visual memory. Secondly, this study will address narrative memory and face memory, which have not been investigated in this group to date. Narrative memory is relevant to functioning in everyday contexts, since it is linked to both academic requirements (reading, writing) and receptive and expressive language (Korkman, Kirk, & Kemp, 2007). Moreover, both narrative and face memories are sensitive to differences in intellectual functioning (Gignac et al., 2016; Korkman et al., 2007). Therefore, deficits are predicted in narrative memory and face memory. Thirdly, this research intends to characterize how children and young people with BIF function in tests that require the interplay between language and executive functions. This includes verbal fluency and rapid naming, since both require: attention; ability for systematic search and retrieval within the time given; verbal working memory; self-monitoring and response control; and processing speed (Norton & Wolf, 2012). In addition, both share access to long-term memory. In the case of rapid naming, a Rapid Automatized Naming (RAN; Digits) task and a Rapid Alternating Stimulus task (RAS; Shapes and Colors) will be used. The multi-componential nature of rapid naming and verbal fluency leads to the prediction of difficulties in BIF children.

Fourthly, this study will analyze the relationship between the WISC-III scores (Full Scale IQ; Verbal IQ; Performance IQ) and the neuropsychological tests scores in the BIF group. This way, we will have an estimate of the degree to which cognitive ability relates to specific neuropsychological abilities in children with BIF. We predict low associations, due to differences in the measures, and the restricted range of the WISC-III scores.

Materials and Method

Sample

The sample included a group with BIF and a control group equivalent in terms of chronological age, gender and socioeconomic level.

Children and adolescents with BIF were selected according to the following inclusion criteria: (a) WISC-III Full Scale IQs (Wechsler, 2003) equal to or greater than 70 but less than 85 (Jankowska et al., 2014; Salvador-Carulla et al., 2013); (b) chronological age between 7 and 15; (c) Portuguese as first language; (d) attending the 1st or 2nd cycle of primary education; (e) absence of visual, auditory, or motor handicaps; (f) exclusion of a specific language impairment, emotional disturbance, disruptive behavior disorder (oppositional defiant disorder and conduct disorder), neurological condition and specific learning disabilities. Nevertheless, and since the BIF group recruitment was lengthy, children with BIF and Attention Deficit Hyperactivity Disorder (ADHD) were included, although in a small number (n = 13) and mainly with the Predominantly Inattentive presentation of ADHD (n = 10; Combined presentation = 3).

The BIF group included 40 participants, with WISC-III Full Scale IQs ranging from 71 to 84 (M = 78.26; SD = 3.677), Verbal IQ ranging from 64 to 99 (M = 82.74; SD = 8.148) and Performance IQ ranging from 66 to 105 (M = 81.41; SD = 8.372), thus displaying a proximity between the means of Verbal and Performance IQs. Twenty-four participants were male (60%) and 16 female (40%), with chronological ages ranging from 7 to 15 years old (M = 10.03; SD = 2.178), and from a high (n = 1; 2.5%), medium (n = 10; 25%) and mostly low (n = 29; 72.5%) Socioeconomic Status (SES). The parents (or their substitutes) SES was determined based on the highest academic and professional level of one of the parental figures, and according to a classification system used with the Portuguese population (Simões, 1994).

The BIF group was recruited in seven school groups/units in Leiria, a coastal district in central Portugal. The BIF group attended the 1st or 2nd cycle of Primary Education, 12 (30.0%) were in the 2nd year, 4 (10.0%) in the 3rd year, 7 (17.5%) in the 4th year, 8 (20.0%) in the 5th year and 9 (22.5%) in the 6th year.

The control group, consisting of 40 participants with no identified problems, was selected from the standardization sample of the Coimbra Neuropsychological Assessment Battery (BANC, Simões et al., 2016). The standardization sample of the BANC is large (N = 1104), was collected through a random stratified sampling procedure and included children that fulfilled the following inclusion criteria: (a) absence of visual, auditory, or motor handicaps; (b) exclusion of a specific language impairment, emotional disturbance, disruptive behavior disorder (oppositional defiant disorder, ADHD and conduct disorder), neurological condition and specific learning disabilities; (c) without referral to any kind of special education services; (d) without any school retentions; (e) at least average academic performance; (f) Portuguese as first language. The 40 children of the control group were selected through a matching methodology of identical pairs. Thus, this group's children and adolescents were chosen one by one, according to the affinities with the subjects from the BIF group, with respect to age (*M* = 10.03; *SD*= 2.178), gender (24 boys and 16 girls) and SES (72.5% low, 25% middle, and 2.5% high).

Instruments

The Portuguese version of the WISC-III (Wechsler, 2003) was used, as well as tests that incorporate the BANC (Simões et al., 2016), which is a broad and comprehensive battery of tests for children and adolescents, aged between 5 and 15. The battery includes 15 tests that are organized in the following theoretically derived domains: Language; Memory; Attention/Executive Functions; Motor Function; Laterality and Orientation. The tests used in this study are part of the Language (Rapid Naming), Memory (Word List, Narrative Memory; Face Memory, Rey Complex Figure) and Attention/Executive Functions (Verbal Fluency) domains.

The information about the reliability of these tests is presented below, and it is based on the psychometric studies carried out with the battery (Simões et al., 2016). Although the BANC has six domains, factor analysis excluded Laterality, Motor Function and Orientation domains, because the first is just an observation task, and the other two were considered outside of psychometric interest (Moura et al., 2017). Confirmatory factor analysis showed that a three-correlated-factor model (Memory, Language, and Attention/Executive Functions) demonstrated the most adequate fit to the data (Moura et al., 2017; Simões et al., 2016).

Word List. This test assesses the aptitude for learning and recalling a list of words. The examiner reads a list of 15 words (Learning List) and the child repeats the maximum number of words that he/she can remember over four trials (Total Learning score). Following this, a new list is presented (Interference List) and recalled by the child only once (Trial and score of Interference List). He or she is then asked to recall the Learning List (Trial and score of Delayed Recall - Short Interval). Twenty to thirty minutes later, the child is asked to recall the Learning List (Trial and score of Delayed Recall - Long Interval), and immediately afterwards, 45 words are presented to the child and he/she is asked to say whether or not they belonged to the Learning List (Trial and Recognition score). In the BANC normative sample (N =1104), this test presented internal consistency values of .89 (Cronbach's α) and .87 (split-half; Simões et al., 2016).

In the Word List test, the following scores were calculated: (a) Learning Total; (b) Interference List Recall; (c) Delayed Recall - Short Interval; (d) Delayed Recall - Long Interval; (e) Recognition; (f) Perseverations - total repeated recalls throughout all trials; (g) Intrusions - total recalled words that were not on the list throughout all trials; (h) Proactive Interference - total words recalled in the first trial of the Learning List minus the total number of words recalled on the Interference List; and (i) Retroactive Interference - total words recalled in the fourth trial of the Learning List minus the total number of words recalled in the Delayed Recall with Long Interval.

Narrative Memory. The examiner reads two stories, and immediately after reading each one, asks the child to retell it (Trial and score of Immediate Recall). Twenty minutes later, the child is instructed to retell them (Trial and score of Delayed Recall), and immediately afterwards, multiple-choice questions are presented about the stories (Trial and score of Recognition). The administration of the stories varies according to the child’s age: (a) young children aged 5-9 years receive stories A and B; and (b) older children aged 10-15 years receive stories C and D. In the BANC sample, the internal consistency of scores in stories A and B was .86 and in stories C and D was .92 (Simões et al., 2016).

Face Memory. This test assesses the ability to recognize faces, presented as photographic images, immediately after their presentation and after a fixed time interval. In the Learning Trial each of the 16 faces is shown for three seconds and the child is asked to remember each one. Then, in the Immediate Recognition Trial, he/she identifies, within sets of three faces, each one of the previously seen faces. After 20 to 30 minutes, in the Delayed Recognition Trial, the child identifies the same faces, also in sets of three. Each series of faces is displayed for five seconds. In the Face Memory, the scores used are based on the number of faces correctly recognized in one (Immediate Recognition; Delayed Recognition) or two trials (total score). In the analysis of this test's reliability, Immediate Recognition showed a test-retest correlation coefficient of .66 and Delayed Recognition showed a correlation coefficient of .59 (both in a one-month interval; Simões et al., 2016).

Rey Complex Figure. This test is a classic measure of visual memory, spatial ability and planning. The child is instructed to observe the figure and copy it to a white sheet (Copy). Three minutes later, the child should draw the figure from memory (Immediate Recall Trial) and twenty to thirty minutes after this trial, he/she re-draws the figure from memory (Delayed Recall Trial). Temporal stability was examined over a period of approximately one month and registered a value of .79 for Immediate Recall and of .81 for Delayed Recall (Simões et al., 2016).

In the Rey Complex Figure test, the following scores were calculated: (a) Total - sum of the scores obtained (accuracy + placement, based on the Meyers and Meyers scoring system (1995)), in each of the 18 units of the figure, in its two trials; and (b) Time - in seconds, which the child took to reproduce the figure in the two trials.

Rapid Naming. The child is asked to name 50 familiar visual stimuli, printed on a card, which appear repeated in random sequences, as quickly as possible. In Rapid Naming of Shapes and Colors, the child must name the two properties of the visual stimuli, and in Rapid Naming of Digits the child names only the digits. Over a one-month interval, the Rapid Naming of Shapes and Colors showed a temporal stability of .90 and the Rapid Naming of Digits .78 (Simões et al., 2016).

In the Rapid Naming of Shapes and Colors and in the Rapid Naming of Digits, the following scores were calculated: (a) Total Time - time spent by the child; (B) Errors - number of errors made; and (c) Naming Time for Correct Answers - time spent on rapid naming divided by the number of correct answers.

Verbal Fluency. This test assesses the ability to generate words according to semantic and phonemic categories. In the Semantic Verbal Fluency test, the child produces as many “animal names” (Item 1), “boy and girl names” (Item 2), and “names of things to eat” (Item 3), as possible, in one minute trials. Then, in the Phonemic Verbal Fluency test, the child names, the maximum possible, words beginning with the phonemes P (Item 4), M (Item 5), and R (Item 6), also for one minute each phoneme. Scores were calculated regarding Semantic Verbal Fluency, Phonemic Verbal Fluency and the Total (sum of correct words). The Phonemic Verbal Fluency registered an internal consistency value of .83, and the Semantic Verbal Fluency registered a value of .87 (Simões et al., 2016).

Procedure

In the initial stage, the project was discussed in detail with staff from public schools in the district of Leiria and consent was obtained from the schools. Next, educational psychologists from those schools were invited to collaborate by identifying students with BIF who had been previously evaluated by the WISC-III (Wechsler, 2003). Students that might have BIF, but didn't have intelligence scores available, were assessed with the WISC-III by the first author. The parents of all the students were contacted. They were informed of the study’s objectives, and parental consent was obtained, authorizing their children to participate in the study via the application of the assessment instruments. Consent had also been obtained from schools and parents regarding the children of the control group.

Once the BIF group was identified, the evaluation protocol was applied, which took place in a session lasting one hour, and included the previously mentioned tests, in the following order: (a) Face Memory - Learning and Immediate Recall Trials; (b) Word List - Learning List Trial, Interference List Trial and Delayed Recall - Short Interval Trial; (c) Rapid Naming of Shapes and Colors and Rapid Naming of Digits; (d) Face Memory - Delayed Recognition Trial; (e) Rey Complex Figure - Copy; (f) Word List - Delayed Recall - Long Interval and Recognition Trials; (g) Rey Complex Figure - Immediate Recall Trial; (h) Narrative Memory - Immediate Recall Trial; (i) Semantic Verbal Fluency and Phonemic Verbal Fluency; (j) Rey Complex Figure - Delayed Recall Trial; and (k) Narrative Memory - Delayed Recall and Recognition Trials.

Statistical Analysis

The data analysis was performed with the IBM SPSS Statistics 20 Package. The groups' raw scores in the neuropsychological tests were compared through a multivariate analyses of variance (MANOVA), whenever its assumptions could be met. Thus, assumptions of the MANOVA were checked, namely: multivariate normality and homogeneity of variance-covariance matrices (Levene's test and Box's test). In addition, the theoretical basis for considering different dependent variables simultaneously was also taken into account (Tabachnick & Fidell, 2007). A MANOVA could be performed regarding Rey Complex Figure, Face Memory and Verbal Fluency. When the MANOVA was significant, ANOVA values are reported.

Other group comparisons of raw scores were made through the *t* test or the Mann-Whitney U test (two-tailed), according to whether or not the distributions of the variables were normal. The significance level was $p < 0.05$. Effect sizes were estimated with Cohen's *d* for ANOVA and the *t* test and the *r* proposed by Cohen (1988; Fritz, Morris, & Richler, 2012) for Mann-Whitney U test.

Within the BIF group, the relationship between the WISC-III IQs standard scores and the neuropsychological tests standard scores was examined through Pearson correlation.

Regarding the neuropsychological tests, only the scores that had standard scores available were included.

Results

Table 1 shows that, in general, when compared with the control group, the BIF group had a poorer performance in verbal memory tests. However, the differences between groups are not invariably statistically significant, especially in the Word List test.

(Insert Table 1)

In the Word List test, statistically significant differences were observed among groups in the following scores: Delayed Recall - Short Interval and Recognition - the mean of the group with BIF was lower than that of the control group; Intrusions and Retroactive Interference - the mean of the group with BIF was higher than that of the control group. The values of effect size *d* or *r* were small or moderate (Cohen, 1988).

In the Narrative Memory test we found statistically significant differences among groups: in all the scores of Narrative Memory C and D (children aged 10 to 15), and the values of effect size *d* were large; in the Immediate Recall of Narrative Memory A and B (children aged 7 to 9), associated with moderate values of effect size *d*. The result of the Delayed Recall of Narrative Memory A and B was close to statistical significance (p = 0.053).

Regarding visual memory, a one-factor MANOVA indicated that the group variable had a statistically significant effect on the scores of the Face Memory (Wilks' λ = 0.895; F (3,76) = 2.957; p = 0.038; η^2= 0.105; η = 0.679.). On the contrary, a one-factor MANOVA indicated no statistically significant effect of the group on the scores of the Rey Complex Figure (Wilks' λ = 0.955; F (4,75) = 0.893; p = 0.472; η^2 = 0.045; η = 0.271*)*. Thus, an ANOVA was performed regarding Face Memory.

Overall, in the visual memory, the BIF group obtained lower scores when compared to the control group. However, the only scores revealing a statistically significant difference between groups relate to the Immediate Recognition of Face Memory (and the Total of Face Memory), both with moderate values of effect size *d*.

(Insert Table 2)

Table 3 shows the results obtained in the Rapid Naming and Verbal Fluency tests.

(Insert Table 3)

The group with BIF systematically presented poorer results than those of the control group on rapid naming tasks, both in relation to the time spent (higher timings) and to the errors made (more misnames and omissions). In addition, and with only one exception (Rapid Naming of Digits Errors), the differences between groups were statistically significant. The values of effect size *r* were moderate.

A one-factor MANOVA was conducted to examine the impact of the group variable on the scores of the Verbal Fluency tests. It indicated a statistically significant effect (Wilks' λ = 0.857; F (2,77) = 6.440; p = 0.003; η^2 = 0.143; η = 0.893), and was followed by an ANOVA. Thus, the group with BIF showed a poorer performance than the control group in all verbal fluency tasks, with statistically significant differences between groups in most of the scores (Total and Phonemic Verbal Fluency), and with moderate effect size values.

(Insert Table 4)

As seen in Table 4, the correlations are predominantly low, in particular concerning Face Memory, Rapid Naming and Semantic Fluency. Moderate correlations were registered regarding the Word List (Delayed Recall - Long Interval) and the Narrative Memory (Stories A and B - Delayed Recall; Stories C and D - Immediate Recall, Delayed Recall and Recognition).

Discussion

One of the objectives of the present research was to compare the short- and long-term verbal and visual memory of children and adolescents with BIF with reference to a control group of equivalent chronological age.

The data are consistent in relation to short-term verbal memory, showing a deficit regardless of the subjects' ages (7-9 years or 10-15 years), in all tests applied (Word List and Narrative Memory), when compared with the control group. This pattern is consistent with the reviewed literature (Alloway, 2010; Henry, 2001; Maehler & Schuchardt, 2009; Van der Molen et al., 2009), whose empirical data pointed to a deficit in the short-term verbal memory of children and young people with BIF, also in relation to a control group of the same chronological age. However, we emphasize that Maehler and Schuchardt (2009), and Van der Molen et al. (2009) used a group that combined individuals with BIF and individuals with mild IDDs. The deficit in the Recognition in the Word List and Narrative Memory C and D also confirm poor retention. In daily functioning, deficits in short-term verbal memory may manifest as mental tracking problems (e.g., to have trouble remembering things, to forget the content of messages, directions and instructions or to lose oneself in verbal tasks).

Regarding long-term verbal memory, the data obtained do not show the same consistency. On the one hand, there is no evidence of deficit (Word List, and Narrative Memory A and B), but, on the other, there is deficit at ages 10-15 (Narrative Memory C and D). That is to say, it may be hypothesized that the long-term verbal memory of the BIF group does not follow the development of the long-term verbal memory of the control group, presenting a deficit as age progresses. This possibility is based on data from the research by Van der Molen et al. (2014), which showed that working memory (verbal and visuo-spatial) and short-term visuo-spatial memory of children and adolescents with BIF continued to develop until the age of 15, whereas the short-term verbal memory did not show evolution from the age of 10 onwards.

Thus, it would be important to study the development of long-term verbal memory in BIF subjects to test this hypothesis.

Analyzing other results in the Word List test, it should be noted that the difficulties in Delayed Recall with Short Interval of the Word List and the forgetting of words from the first list, when the list of interference is learned (retroactive interference), show an important interference effect in the group with BIF and the difficulty in dealing with the demands of two tasks. The susceptibility to interference tends to decrease between ages 7-13 and in adolescence (Fiducia & O'Leary, 1990), and this process may be slower in subjects with BIF. Intrusions also tend to decline with age (Fiducia & O'Leary, 1990), but are equally important in the BIF group. A high number of intrusions, or higher than expected for a certain age, may indicate difficulty in controlling behavior. This possibility is compatible with the presence of errors in the Rapid Naming of Shapes and Colors Test. Notwithstanding, subjects with high susceptibility to interference may, in an academic perspective, benefit from a sharper separation of tasks that require memorization.

Narrative Memory not only assesses the ability to learn, retain, recall and recognize auditory/verbal material, but also the ability to plan, organize, sequence and understand the story's content both in terms of its main ideas and its details. Equally important to Narrative Memory is the subject's attention to the story, as well as verbal expression (semantic and syntactic) (Baron 2004). It holds distinct and more important demands than the Word List, which in turn translates into more noticeable difficulties for children with BIF in Narrative Memory than in the Word List. Comparing both instruments, it is possible to note that the stories' structure and meaning did not facilitate their recall, but rather that the semantic and syntactic demands and the amount of information compromised the recall. However, in order to circumscribe the origins of BIF children's difficulties, in the future, it would be important to analyze which elements of the stories the subjects have retained (e.g. main ideas or details), and how they have organized and sequenced them (in order to identify possible difficulties in this regard).

Given the ecological validity of Narrative Memory, it is possible to consider that children with BIF may be at a disadvantage in academic situations where information is presented aurally, particularly when the information is complex. Narrative memory is also related to reading comprehension, language comprehension, oral and written expression (Korkman et al., 2007). Thus, children with BIF may have trouble retelling and understanding an oral or written story/sequence of events, as well as organizing and writing a story.

The fact that performance is poorer in Narrative Memory C and D than in Narrative Memory A and B may lie, as previously mentioned, in the pace of development, but also in the stories' content. In fact, Stories A and B, as they are aimed at younger children, address familiar events (The Birthday Party, A Day at the Beach), while Stories C and D, being targeted at older children, deal with unfamiliar events (An Airplane Flight; The Iberian Lynx).

Regarding short-term visual memory, this study verified that there was a deficit in the BIF group in Face Memory. However, the deficit was not noticed in the assessment with the Rey Complex Figure. As previously noted, the reviewed empirical data are inconsistent, since they revealed a deficit in the visuo-spatial short-term memory in the studies of Alloway (2010), Maehler and Schuchardt (2009), Schuchardt et al. (2010), and Van der Molen et al. (2009), but not in Henry's research (2001). If we only consider those studies comparing BIF (and non-MIDs) and control groups (Alloway, 2010; Henry, 2001; Schuchardt et al., 2010), the results obtained in the present study are in line with Henry's research data (2001). In turn, the results in Face Memory broaden the available empirical basis and point to a deficit in the immediate visual recognition of faces by children with BIF. The fact that face recognition progresses gradually throughout childhood and adolescence (Croydon et al., 2014) may be at the source of the difference between the BIF group and the control group.

Regarding long-term visual memory, for which no studies were found in the literature, there is no evidence of deficit in BIF subjects. In the future, it will be relevant to verify whether this observation is confirmed and whether the long-term visual memory effectively represents a strength. If this is confirmed, then visual supports that complement the information presented orally can have beneficial effects on the acquisition, encoding and retrieval of information.

As for rapid naming, children with BIF performed significantly slower than peers with the same chronological age in RAN and RAS tasks. Rapid naming tests evaluate multiple functions, especially those related to language and executive functions (Albuquerque & Simões, 2010; Norton & Wolf, 2012). In addition, subjects with BIF made more errors in the RAS task, a result that confirms that, in cognitive and linguistic terms, this is a more demanding task than RAN (Albuquerque & Simões, 2010), namely in terms of attention, cognitive flexibility and inhibition of irrelevant information. Therefore, the difficulty in coordinating and synchronizing different processes compromises the test's accuracy.

Furthermore, in relation to language and executive functions, more specifically to verbal fluency, the BIF group demonstrated a phonemic fluency deficit when compared to the control group. Van der Molen et al. (2007) also used semantic and phonemic verbal fluency tests, but in a group that included BIF and mild IDDs (MIDs), and that did not distinguish between them. They found that the MIDs group showed a significantly lower performance than the control group both in semantic and phonemic fluency. The circumstance that it is a group with MIDs may justify the divergence of our data with those of the aforementioned study, with respect to semantic verbal fluency. The fact that semantic verbal fluency is easier than phonemic can also be a possible explanation: in phonemic, subjects have to create their own categories to retrieve the information stored in the lexicon, and this task depends on the ability to spell (Baron, 2004; Lezak, Howieson, Bigler, & Tranel, 2012), and alphabet knowledge (Simões et al., 2007); in semantics, the recall depends on the search of categories in the mental lexicon, where the knowledge is already organized, and, therefore, the semantic production is more quickly developed (Baron, 2004; Lezak et al., 2012). Thus, the problems with phonemic fluency indicate that children with BIF have problems with accessing items based on the knowledge of spelling and sound patterns in words (Danielsson, Henry, Messer, & Rönnberg, 2011).

Rapid naming is an important predictor for reading, particularly reading fluency (Norton & Wolf, 2012), and phonemic fluency is also relevant in learning to read. Since the BIF group displayed difficulties in rapid naming and phonemic fluency, it would be important to analyze the respective associations to the learning of written language. It should be noted that the academic performance profile of children and adolescents with BIF is still to be defined, as well as their associations to neuropsychological functions.

The relationship between the WISC-III and the neuropsychological tests in the BIF group was predominantly weak. However, when evaluating relationships between these measures, it is important to consider that intelligence measures assess multiple, integrated cognitive functions, whereas neuropsychological tests usually have a more restricted focus. Therefore, correlations between measures of general cognitive ability and neuropsychological batteries for children, such as the NEPSY (Korkman, Kirk, & Kemp, 1998), the NEPSY-II (Korkman et al., 2007), or the BANC (Simões et al., 2016), are usually in the low to moderate range. For instance, Face Memory displayed very low correlations with the WISC-III (Korkman et al., 1998; Simões et al., 2016), or the WISC-IV (Korkman et al., 2007), in typically developing children, and the same was observed in the BIF group. Memory tests, such as Narrative Memory, are more related with intelligence scores (Korkman et al., 1998, 2007), as shown in the BIF group. Nevertheless, the WISC-III/neuropsychological tests correlations in the BIF group were lower than those observed in the standardization samples of neuropsychological batteries for children (Korkman et al., 1998, 2007; Simões et al., 2016), in particular in what concerns rapid naming and semantic verbal fluency. This may be due to the restriction of range of the IQs of the BIF group, since the value of *r* is lower when the variability is lesser (Goodwin & Leech, 2006). Attenuated correlations between the IQs and neuropsychological tests have also been observed in clinical groups other than BIF (Korkman et al., 1998), and in conjoint these results support the concept of a dissociation between intellectual ability and domains of specific cognitive functions.

In terms of the study's limitations, the first one is that comorbid conditions, namely ADHD, have not been controlled. This comorbidity was present in almost one third of the children with BIF, who had been identified mainly with the Predominantly Inattentive presentation of ADHD. As it is well-known, children with ADHD have deficits on spatial working memory, processing speed and executive functions (e.g., inhibition, vigilance and planning; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005), and so it is possible that some of the neurocognitive impairments observed in the present study are due to the ADHD. In future studies, it would be important to address children with comorbid BIF and ADHD, since these children tend to be excluded from studies concerning ADHD, BIF and intellectual disabilities. As practically nothing is known about this comorbidity, neuropsychological studies should assess and compare the impact of BIF and of combined BIF and ADHD.

The second limitation is relative to the control group. As previously mentioned the children of this group were selected from the standardization sample of the BANC and had to fulfill many criteria, such as the exclusion of neurodevelopmental and disruptive behavior disorders, the inexistence of referral to special education services and the absence of any school retention. Although these criteria were intended to assure a normal intellectual functioning, most of the children of the standardization sample have not been assessed with an intelligence test. Therefore, it is uncertain that all children of the control group have Full Scale IQ superior to 85.

The third limitation regards the smaller number of children with BIF in the Narrative Memory test, since the group was split in two (n =18; n = 22), according to the children age and test version (stories A and B – children aged 7 to 9; stories C and D – children aged 10 to 15). This may had led to loss of statistical power.

The fourth limitation concerns the multi-componential nature of some instruments (e.g., Narrative Memory, Rapid Naming), which makes it difficult to accurately identify the sources of BIF subjects' difficulties.

Conclusions

In summary, this research represents a step towards characterizing the neuropsychological functioning of a group of children and adolescents with BIF. Its seven major conclusions are:

1) Children with BIF showed a deficit in short-term verbal memory, as well as an important interference effect.
2) Long-term verbal memory was impaired only in older children.
3) Recalling and retelling oral stories was difficult for children with BIF, who may be at a disadvantage when complex information is presented aurally.
4) Long-term visual memory showed no deficit.
5) Difficulty in coordinating different cognitive processes was manifest in rapid naming tests.
6) The BIF group displayed a phonemic fluency deficit that in association with a poor performance in rapid naming, may have a negative impact on written language.
7) Correlations between WISC-III and neuropsychological tests scores were predominantly low, thus supporting the importance of using both types of measures.

In short, children and adolescents with BIF should continue to be studied on their own rather than in conjunction with Intellectual Disabilities (IDs).

Declaration of interest

The authors report no declarations of interest.

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References

Albuquerque, C. P., & Simões, M. R. (2010). Rapid naming tests: Developmental course and relations with neuropsychological measures. *The Spanish Journal of Psychology, 13*(1), 88-100. doi: 10.1017/S1138741600003693

Alloway, T. P. (2010). Working memory and executive function profiles of individuals with borderline intellectual functioning. *Journal of Intellectual Disability Research*, *54*, 448-456. doi: 10.1111/j.1365-2788.2010.01281.x

American Psychiatric Association [APA] (2013). *Diagnostic and statistical manual of mental disorders: DSM-5*. Arlington, VA: Author.

Baron, I. S. (2004). *Neuropsychological evaluation of the child*. New York: Oxford University Press.

Bexkens, A., Van der Molen, M. W., Collot d'Escury-Koenigs, A. M. L., & Huizenga, H. M. (2014). Interference control in adolescents with mild-to-borderline intellectual disabilities and/or behavior disorders. *Child Neuropsychology, 20*(4), 398-414. doi: 10.1080/09297049.2013.799643

Bonifacci, P., & Snowling, M. J. (2008). Speed of processing and reading disability: A cross-linguistic investigation of dyslexia and borderline intellectual functioning. *Cognition, 107*, 999-1017. doi: 10.1016/j.cognition.2007.12.006

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2^{nd} ed.). Hillsdale, NJ: Erlbaum

Croydon, A., Pimperton, H., Ewing, L., Duchaine, B. C., & Pelicano, E. (2014). The Cambridge Face Memory Test for Children (CFMT-C): A new tool for measuring face recognition skills in childhood. *Neuropsychologia*, *62*, 60-67.

Danielsson, H., Henry, L., Messer, D., & Rönnberg, J. (2011). Strengths and weaknesses in executive functioning in children with intellectual disability. *Research in*

Developmental Disabilities, *33*, 600-607.

Fernell, E., & Ek, U. (2010). Borderline intellectual functioning in children and adolescents - insufficiently recognized difficulties. *Acta Paediatrica*, *99*, 748-753. doi: 10.1111/j.1651-2227.2010.01707.x

Fiducia, D., & O'Leary, D. S. (1990). Development of a behavior attributed to the frontal lobes and the relationship to other cognitive functions. *Developmental Neuropsychology*, *6*(2), 85-94.

Fritz, C. O., Morris, P. E., & Richler, J. J. (2012). Effect size estimates: Current use, calculations and interpretation. *Journal of Experimental Psychology: General*, *141*, 2-18. doi: 10.1037/a0024338

Gignac, G. E., Shankaralingam, M., Walker, K., & Kilpatrick, P. (2016). Short-term memory for faces relates to general intelligence moderately. *Intelligence*, *57*, 96-104.

Goodwin, L. D., & Leech, N. L. (2006). Understanding correlation: Factors that affect the size of *r*. *The Journal of Experimental Education*, *74*(3), 251-266.

Hasselhorn, M., & Mähler, C. (2007). Phonological working memory of children in two german special schools. *International Journal of Disability, Development and Education, 54*(2), 225-244. doi: 10.1080/10349120701330545

Henry, L. A. (2001). How does the severity of a learning disability affect working memory performance? *Memory, 9*, 233-247. doi: 10.1080/09658210042000085

Jankowska, A. M., Bogdanowicz, M., & Takagi, A. (2014). Stability of WISC-R scores in students with borderline intellectual functioning. *Health Psychology Report, 2*(1), 49-59. doi: 10.5114/hpr.2014.42789

Kaznowski, K. (2004). Slow learners: Are educators leaving them behind? *National Association of Secondary School Principals Bulletin*, *88*(641), 31-45.

Korkman, M., Kirk, U., & Kemp, S. L. (1998). *NEPSY. A developmental neuropsychological* *assessment*. San Antonio: Psychological Corporation.

Korkman, M., Kirk, U., & Kemp, S. L. (2007). *NEPSY-II. Clinical and interpretive manual.* Bloomington: Pearson.

Lezak, M. D., Howieson, D. B., Bigler, E. D., & Tranel, D. (2012). *Neuropsychological assessment* (5th ed.). New York: Oxford University Press.

Maehler, C., & Schuchardt, K. (2009). Working memory functioning in children with learning disabilities: Does intelligence make a difference? *Journal of Intellectual Disability Research, 53*(1), 3-10. doi: 10.1111/j.1365-2788.2008.01105.x

Meyers, J. E., & Meyers, K. R. (1995*). Rey Complex Figure Test and Recognition Trial: Professional manual*. Lutz, FL: Psychological Assessment Resources.

Moura, O., Albuquerque, C. P., Pinho, M. S., Vilar, M., Lopes, A. F., Alberto, I., ... Simões, M. R. (2017). Factor structure and measurement invariance of the Coimbra Neuropsychological Assessment Battery (BANC) in children aged 7 to 15 years. *Archives of Clinical Neuropsychology.* Advance online publication. doi:10.1093/arclin/acx052

Norton, E. S., & Wolf, M. (2012). Rapid automatized naming (RAN) and reading fluency: Implications for understanding and treatment of reading disabilities. *Annual Review of Psychology*, *63*, 427-452. doi:10.1146/annurev-psych-120710-100431

Poloczek, S., Henry, L. A., Danielson, H., Büttner, G., Mähler, C., Messer, D. J., Schuchardt, K., & Van der Molen, M. J. (2016). Strategic verbal rehearsal in adolescents with mild intellectual disabilities: A multi-centre European study. *Research in Developmental Disabilities*, *58*, 83-93.

Salvador-Carulla, L., García-Gutiérrez, J. C., Gutiérrez-Colosía, M. R., Artigas-Pallarès, J., Ibáñez, J. C., Pérez, J. G., ... Martínez-Leal, R. (2013). Funcionamiento intelectual límite: Guía de consenso y buenas prácticas [*Borderline Intellectual Functioning:*

Consensus and good practices guidelines]. *Revista de Psiquiatría y Salud Mental, 6*(3), 109-120. doi. 10.1016/j.rpsm.2012.12.001

Schuchardt, K., Gebhardt, M., & Mäehler, C. (2010). Working memory functions in children with different degrees of intellectual disability. *Journal of Intellectual Disability Research, 54*(4), 346-353. doi: 10.1111/j.1365-2788.2010.01265.x

Simões, M. R. (1994). *Investigações no âmbito da aferição nacional do teste das Matrizes Progressivas Coloridas de Raven (M. P. C. R.)* (Tese de doutoramento) [*National normative studies of the Raven's Coloured Progressive Matrices Test*]. (Doctoral dissertation). Coimbra: Universidade de Coimbra.

Simões, M. R., Albuquerque, C. P., Pinho, M. S., Vilar, M., Pereira, M., Lopes, A. F., ... Moura, O. (2016). *Bateria de Avaliação Neuropsicológica de Coimbra (BANC). Manual técnico* [*Coimbra Neuropsychological Assessment Battery. Technical Manual*]. Lisboa: Cegoc.

Simões, M. R., Pinho, M. S., Lopes, A. F., Santos, L., Alfaiate, C., Fernandes, E., ...Vilar, M. (2007). Teste de fluência verbal semântica [*Semantic verbal fluency test*]. In M. R. Simões, C. Machado, M. M. Gonçalves, & L. S. Almeida (Eds.), *Avaliação psicológica: Instrumentos validados para a população portuguesa Vol III* (pp. 281-304). Coimbra: Quarteto.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston: Pearson.

Van der Molen, M. J., Henry, L. A., & Van Luit, J. E. H. (2014). Working memory development in children with mild to borderline intellectual disabilities. *Journal of Intellectual Disability Research, 58*(7), 637-650. doi: 10.1111/jir.12061

Van der Molen, M. J., Van Luit, J. E. H., Jongmans, M. J., & Van der Molen, M. W. (2007). Verbal working memory in children with mild intellectual disabilities. *Journal of*

Intellectual Disability Research, 51(2), 162-169. doi: 10.1111/j.1365-2788.2006.00863.x

Van der Molen, M. J., Van Luit, J. E. H., Jongmans, M. J., & Van der Molen, M. W. (2009). Memory profiles in children with mild intellectual disabilities: Strengths and weaknesses. *Research in Developmental Disabilities, 30*, 1237-1247. doi: 10.1016/ j.ridd.2009.04.005

Van der Molen, M. J., Van Luit, J. E. H., Van der Molen, M. W., Klugkist, I., & Jongmans, M. J. (2010). Effectiveness of a computerized working memory training in adolescents with mild to borderline intellectual disabilities. *Journal of Intellectual Disability Research, 54*(5), 433-447. doi: 10.1111/j.1365-2788.2010.01285.x

Wechsler, D. (2003). *WISC-III - Escala de Inteligência de Wechsler para Crianças III* [*WISC-III- Wechsler Intelligence Scale for Children*]. Lisboa: CEGOC-TEA.

Willcutt, E. G., Doyle, A. E., Nigg, J. T., Faraone, S. V., & Pennington, B. F. (2005). Validity of the executive function theory of Attention-Deficit/Hyperactivity Disorder: A meta-analytic review. *Biological Psychiatry*, *57*(11), 1336–1346. http://doi.org/10.1016/j.biopsych.2005.02.006

Table 1 –Verbal Memory: Comparison of the BIF and control groups

		BIF (*n* =40)		**Control** (*n* =40)					
		M	*SD*	*M*	*SD*	*t*	*U*	*p*	*d/r*
Word List	**Total Learning**	34.00	7.046	35.30	7.151	-0.819		0.415	0.18
	Recall Interference List	5.250	1.836	5.328	1.706	-0.196		0.845	0.04
	Delayed Recall - Short Interval	7.70	2.388	8.80	2.210	-2.138		0.036	0.48
	Delayed Recall - Long Interval	8.327	2.174	9.075	2.454	-1.355		0.179	0.30
	Recognition	39.63	3.927	41.70	2.972		527.00	0.008	0.30
	Perseverations	7.10	8.390	6.40	5.472		779.00	0.839	0.02
	Intrusions	5.92	6.407	2.70	2.594		589.00	0.040	0.23
	Proactive Interference	0.597	2.015	0.950	1.853	-0.814		0.418	0.18
	Retroactive Interference	2.725	1.961	1.648	1.551	2.726		0.008	0.61
Narrative Memory	Stories A and B (*n* = 18)								
	Immediate Recall	38.28	9.080	45.06	9.920	-2.138		0.040	0.71
	Delayed Recall	35.222	9.201	41.667	10.105	-2.001		0.053	0.67
	Recognition	25.06	3.977	26.17	3.400	-0.901		0.374	0.30
	Stories C and D (*n* = 22)								
	Immediate Recall	19.227	6.704	28.136	11.340	-3.172		0.003	0.96
	Delayed Recall	18.14	6.143	25.41	11.249	-2.661		0.012	0.80
	Recognition	18.45	4.160	22.14	3.668	-3.114		0.003	0.94

Table 2 – Visual Memory: Comparison of the BIF and control groups

		BIF (*n* =40)		**Control** (*n* =40)				
		M	*SD*	*M*	*SD*	*F*	*p*	*d*
Face Memory	**Immediate Recognition**	11.58	2.809	13.10	2.489	6.604	0.012	0.57
	Delayed Recognition	12.23	2.939	13.23	2.455	2.728	0.103	0.37
	Total	23.90	5.113	26.43	4.373	5.634	0.020	0.53
Rey Complex Figure	Immediate Memory							
	Total	13.688	6.146	15.200	6.402			
	Time	152.85	67.654	173.55	91.360			
	Delayed Memory							
	Total	13.375	5.781	15.338	6.279			
	Time	112.80	47.897	120.58	48.416			

Table 3 – Language and executive functions: Comparison of the BIF and control groups

		BIF (*n* =40)		**Control** (*n* =40)					
		M	*SD*	*M*	*SD*	*F*	*U*	*p*	*d/r*
Rapid Naming	Shapes and Colors								
	Time	147.75	68.118	107.55	54.302		430.00	0.000	0.40
	Errors	7.05	11.666	1.17	3.281		482.50	0.001	0.36
	Time Naming Correct Answers	1.655	0.878	1.107	0.666		405.00	0.000	0.42
	Digits								
	Time	38.00	22.666	25.50	6.668		413.00	0.000	0.42
	Errors	0.13	0.648	0.03	0.158		779.50	0.549	0.07
	Time Naming Correct Answers	0.728	0.345	0.510	0.133		412.50	0.000	0.42
Verbal Fluency	**Semantic**	40.55	11.243	43.40	12.440	1.156		0.286	0.24
	Phonemic	13.10	6.464	18.48	7.729	11.382		0.001	0.76
	Total	53.65	16.034	61.88	18.297	4.572		0.036	0.48

Table 4 – Pearson Correlation between WISC-III IQs and neuropsychological tests standard scores

		Full Scale IQ	Verbal IQ	Performance IQ
Word List	**Total Learning**	0.02	-0.12	0.18
	Recall Interference List	0.17	-0.07	0.19
	Delayed Recall - Short Interval	0.27	0.26	0.00
	Delayed Recall - Long Interval	0.31	0.15	0.10
	Recognition	0.15	-0.01	0.15
Narrative Memory	Stories A and B (*n* = 18)			
	Immediate Recall	0.18	-0.11	0.22
	Delayed Recall	0.33	0.06	0.20
	Recognition	0.17	-0.02	0.12
	Stories C and D (*n* = 22)			
	Immediate Recall	-0.06	0.40	-0.37
	Delayed Recall	-0.04	0.45*	-0.40
	Recognition	-0.22	0.38	-0.45*
Face Memory	**Immediate Recognition**	0.18	-0.04	0.15
	Delayed Recognition	0.09	0.19	-0.09
Rey Complex Figure	Immediate Memory			
	Total	-0.00	-0.11	0.11
	Delayed Memory			
	Total	0.16	-0.14	0.27
Rapid Naming	Shapes and Colors			
	Time	-0.09	-0.05	0.03
	Digits			
	Time	-0.09	-0.01	-0.06
Verbal Fluency	**Semantic**	0.08	0.06	0.02
	Phonemic	0.07	0.24	-0.09

* $p < 0.05$