

Evaluating Reading and Metacognitive Deficits in Children and Adolescents with Attention Deficit Hyperactivity Disorder

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The reading achievement of children and adolescents with Attention Deficit Hyperactivity Disorder (ADHD) has scarcely been explored in research conducted in the Spanish language and when it has, the results have been contradictory. The focus of the present research is to analyze participants' reading competency and metacognitive strategies as they carry out reading comprehension tasks. The sample was comprised of 187 Argentine schoolchildren aged 9 to 13 years old. 94 constituted the control group and the clinical group consisted of 93 schoolchildren diagnosed with ADHD. The metacognitive assessment was made up of two metacognitive tests, the Reading Awareness Scale (ESCOLA; acronym in Spanish) and a Spanish adaptation of Metacognitive Awareness of Reading Strategies Inventory (MARS), and one test of reading comprehension, the Evaluation of Reading Processes for Secondary Education Students (PROLEC-SE; acronym in Spanish). Students with ADHD had lower achievement on tests of reading comprehension compared to the control group. Nevertheless, our results suggest their difficulties did not stem from reading comprehension problems, but rather from alterations in their Executive Functions, because when subjects' reading comprehension was equalized, students with ADHD still exhibited a lower level of Metacognition, particularly when it came to planning.

Keywords: ADHD, reading disabilities, metacognition.

El rendimiento lector en relación con la metacognición en niños y adolescentes con trastorno por déficit de atención con hiperactividad (TDAH) ha sido escasamente explorado en el ámbito de habla hispana, y en aquellos casos que lo han abordado, los resultados son contradictorios. La presente investigación analiza las competencias y uso de estrategias metacognitivas durante la realización de tareas de comprensión lectora. La muestra estuvo compuesta por 187 escolares argentinos de edades comprendidas entre los 9 y los 13 años; 94 de ellos constituyeron el grupo control y otros 93 el grupo clínico formado por escolares diagnosticados con TDAH. La evaluación metacognitiva se realizó utilizando la escala de conciencia lectora (ESCOLA) y una adaptación al español del metacognitive awareness of reading strategies inventory (MARS). Adicionalmente, para conocer el nivel de comprensión lectora se administraron varios textos seleccionados de la prueba de evaluación de procesos lectores (PROLEC-SE). Los TDAH mostraron un rendimiento inferior en los tests de comprensión lectora en comparación con el grupo control; no obstante, nuestros resultados sugieren que sus dificultades no se explican tanto como un problema de comprensión lectora sino como una alteración en su función ejecutiva, puesto que, igualando a los sujetos en comprensión lectora, los TDAH siguen mostrando un nivel inferior de metacognición, particularmente en lo que se refiere a los procesos de planificación.

Palabras clave: TDAH, déficit lector, metacognición.

The authors are grateful to Dr. Enrique Menzano, Director of Neurological Services at San Isidro Hospital; without his enthusiastic collaboration, this research would not have been possible. Also to the facilities and support from Labarden, Santa Inés, San Andrés Punta Chica and San Andrés Olivos schools, located in northern Buenos Aires (Argentine).

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The purpose of the present study is to examine the cognitive functioning of patients with Attention Deficit Hyperactivity Disorder (ADHD) in order to discover the impact of the executive functions on metacomprehension. Our primary hypothesis is that those with ADHD will perform worse on tests of metacomprehension since they must invest more cognitive resources to recognize words with exactitude and ease.

ADHD is among the most polemic and widely debated syndromes in the area of special education (Cardo & Servera, 2003). ADHD is a condition in which children and adolescents exhibit a variety of inappropriate behaviors such as hyperactivity, impulsivity and inattention that combine differently in each, individual case, giving way to different diagnostic sub-types (see DSM-IV, 1995 and DSM-IV-TR, 2000).

Between 3 and 7% of school-age children (APA, 2002; Cardo, Servera & Llobera, 2007) are believed to suffer from ADHD, although attempts to determine its rate are hindered by several factors: variations in the way diagnostic criteria are clinically classified (Maldonado, Trianes, Cortés, Moreno & Escobar, 2009), the methods of diagnostic evaluation used, the source of information (parent, guardian, teacher), the type of sample (clinical or general population) and demographic and sociocultural characteristics (such as sex, age, maturity level, socioeconomic status, etc. Biederman et al., 1996). The concept of ADHD has developed over the years; at first, it was believed that its main dimension was excessive motor activity; next, importance was cast on the element of hyperactivity, which was considered to accompany a substantial deficit in the ability to pay attention. Finally, the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV) describes ADHD as characterized by lack of attention (Assef, Capovilla, & Capovilla, 2007) and hyperactivity/impulsivity.

Brown (2000) posited that comorbid disorders associated with ADHD essentially determine the course and prognosis of the disorder. Pure cases of ADHD are very rare (Miranda-Casas, Ygual-Fernández, Mulas-Delgado, Roselló-Miranda, & Bo, 2000); it is usually found to occur alongside other, associated problems of a different nature, which seem to largely condition its outcome, as shown in studies by Blondis, Roizen, and Fiskin (1995), Roselló, Amado, and Bo (2000), and Kadesjo and Gillberg (2001).

ADHD and reading disability (RD) typically appear to be comorbid and associated with one another. Reading is a biphasic process that involves both word recognition and comprehending written messages (Carrol, 1964). The process of comprehension is more complex than simple word recognition and is tied to higher cognitive functions. The few studies out there on comorbidity between ADHD and RD, and word recognition have in some cases produced contradictory or divergent results. Still, there has been a considerable lack of empirical research

analyzing the comprehension and recognition components of metacognition, factors that may actually galvanize the development of ADHD.

It is estimated that the comorbidity of ADHD + RD is between 15% and 50%, depending on the criteria used to identify them (August & Garfinkel, 1990; Semrud-Clikeman et al., 1992; Willcutt & Pennington, 2000). This close association between both disorders may be due to the psycholinguistic (phonological, metaphonological, morphosyntactic and semantic processing) and visual perceptual deficits (visuospatial coordination, recognizing spatial differences and right-left orientation) experienced by students with ADHD from their Early Education (Ygual & Marco, 2008) onward. Various methodologies have been employed to study this comorbidity. First, epidemiological exploration has been used (with large samples) to determine whether or not comorbidity is a mere artifact of clinical testing. Some researchers have observed comorbidity in epidemiological and clinical samples alike, therefore concluding it was no mere artifact (Cantwell & Baker, 1991; Dykman & Ackerman, 1991). Others, however, have not found that to be true, only observed it in a few cases (Dalby, 1985), and when they did observe it, found they were more likely to do so if the RD subjects were selected before those with ADHD (Shaywitz & Shaywitz, 1991). Shallice (1988) suggested using double dissociation to reach a differential diagnosis; in this test, the two disorders ought to exhibit opposite profiles when comparing certain aspects that are considered central to one of the disorders but not the other. Generally speaking, subjects with RD exhibit specific verbal deficits, while those with ADHD exhibit less specific symptoms, and ones that are more difficult to localize in the brain. This did not stop certain neurologists from positing that the greatest deficit exhibited by people with ADHD is in the executive functions, that is, functions tied to planning, executing, and regulating activity (Luria, 1980; Shallice, 1988).

Studies of the comorbidity of ADHD and RD have focused mostly on word recognition. Nevertheless, as far as these authors know, no studies have been conducted on comorbidity between ADHD, reading comprehension, and metacognition. According to follow-up studies, there seem to be no significant differences between adults with and without ADHD in terms of their achievement on word recognition tasks or their phonological ability, but lower performance has been observed on tests of textual comprehension (Samuelson, Lundberg, & Herkner, 2004). Perhaps this is because reading comprehension is significantly related to higher cognitive functions such as planning, making inferences, organizing and constructing meaning, and the executive control functions altered by ADHD.

Difficulty with reading comprehension has been found to be tied to the executive functions. In the 1990s, certain malformations in the brains of subjects with ADHD

were observed using brain-imaging techniques. These malformations are responsible for the cognitive and behavioral symptoms of ADHD. Norman and Shallice (1986) designed a model called the Supervised Attention System (SAS) that aims to represent the way in which the cognitive system exerts control over our actions. The SAS is located in the frontal lobes and intervenes in planning, organization and control functions. According to frontal lobe syndrome researchers (Harris, 1995; Stuss & Benson, 1986; Weyandt & Willis, 1994), when a patient has damage to these lobes, the SAS is altered, producing the following symptoms: (a) loss of self-control and self-regulation in executing tasks, (b) difficulty focusing attention, (c) susceptibility to distraction, (d) attentional inflexibility, (e) behavioral agitation, (f) accelerated action, and (g) deterioration of certain automatisms. Lezak (1995) broadened our understanding of this regulatory functioning by referring to it as a set of abilities including planning, programming, regulation, and volition, or intentional behavior.

Stuss and Alexander (2000) proposed the “executive” concept (activity of the frontal lobes), rather than a set of abilities, as changes in the cognitive activity related to metacognition, which would be the first to be affected by frontal lobe trauma or dysfunction. Another take on the executive functions, from the perspective of processes, emphasizes the activities of inhibitory control and metacognition, positing them as indispensable elements needed to generate complex strategies during reading comprehension and situational analysis tasks (Carlson, Moses, & Hix, 1998). The period when the executive functions develop the most is between the ages of six and eight years-old, also a critical time in reading development. During this time, children acquire the capacity to self-regulate their behavior, set goals, and anticipate events without external instructions, yet a certain amount of lack of control and impulsivity remain. This cognitive ability is clearly tied to developing the regulatory function of language (internal language), the appearance of formal logic operations, and maturation in the prefrontal areas of the brain, which occurs late in the process of child development (Golden, 1981; Luria, 1966, 1973; Passler, Isaac, & Hynd, 1985; Vygotsky, 1978). During development, a high metacognitive level should be reached so as to acquire the capacity for conscious, intentional mental activity (Welsh & Pennington, 1988).

The present research stems from the metacognitive model conceived of by Flavell (1976, 1981) and Brown (1977, 1980). According to those authors, metacognition consists of two inter-related dimensions: understanding cognition and regulating cognition. The first refers to what we know about cognition and includes three forms of knowledge: declarative, procedural and conditional (Jacobs & Paris, 1987), referring to three different variables (person, task and strategy). Regulating cognition, on the other hand,

includes these three processes: planning, supervision and evaluation. Planning involves selecting strategies and distributing resources. Supervising refers to regulating and self-evaluating the abilities necessary to achieve control over the reading task. Evaluating means assessing the results as well as regulatory processes.

Toward the objective of analyzing the possible relationship between ADHD, reading comprehension, and metacognitive competencies, two groups (control and clinical) were administered a classic test of reading comprehension called the PROLEC-SE (Cuetos & Ramos, 1999) and two tests of metacognition: the Reading Awareness Scale, or ESCOLA test (Puente, Jiménez, & Alvarado, 2009), and the MARSÍ (Metacognitive Awareness of Reading Strategies Inventory) by Mokhtari and Reichard (2002). The ESCOLA test enables one to assess how participants perceive themselves as readers, and which strategies they believe are best for solving reading and textual comprehension problems. The MARSÍ test is based on the theory that self-report instruments are capable of measuring the strategies utilized when reading academic texts. Mokhtari and Reichard work from the premise that constructing meaning from a text is a deliberate, intentional activity. Learning from a text, like any other type of learning, requires the reader to be “strategically” implicated in creating meaning (Alexander & Jetton, 2000). Both the ESCOLA and the MARSÍ are considered useful tools to evaluate and promote awareness of the learning processes required in reading.

In summary, the present study has the following objectives: a) to examine the executive functions of students in a population with ADHD by evaluating metacognition as it applies to situations, processes, and variables involved in reading comprehension and, b) to evaluate the diagnostic utility of metacognitive tests in classifying symptoms characteristic of students with ADHD, compared to subjects with similar characteristics who do not have this disorder.

Methods

Sample

The sample was comprised of 187 Argentine students, 93 with ADHD (52% male and 48% female) and 94 who formed the control group (56% male and 44% female). They ranged in age from 9 to 13 years old (ADHD group: average age of 11.50 years-old, $SD = 1.43$; control group: average age of 10.40 years-old, $SD = 0.56$). The control group consisted of students from three schools in northern Buenos Aires (Argentina). The clinical group included students from similar socioeconomic areas as the control group, but who had been diagnosed with ADHD (by Dr. Enrique Menzano, Director of Neurological Services at San Isidro Hospital). The selection criteria for subjects were the following:

- *Inclusion Criteria for the Clinical Group:* (a) Clinical diagnosis of ADHD according to the criteria described in the DSM-IV-TR, (b) People with comorbid neurological disease were excluded, (c) Educated in the normalized school system, (d) Had not been treated with pharmaceuticals at least 24 hours prior to evaluation and (e) Had not received psychological and/or psychopedagogical treatment prior to evaluation.
- *Inclusion Criteria for the Control Group:* (a) No history of neurological or psychiatric disorder, or behavioral or cognitive problems, (b) Not meeting any of the DSM-IV-TR's criteria for a clinical diagnosis of ADHD, (c) Receiving no psychopharmacological, psychological or psychopedagogical treatment.

Instruments

Test of Reading Comprehension. To measure reading competency, we utilized the PROLEC-SE (Cuetos & Ramos, 1999), specifically the following texts from the test were employed: (a) The Eskimos: this is a narrative text administered as a group consisting of 338 words. After reading it, respondents answer 10 questions (5 literal and 5 inferential). The maximum reading time is 15 minutes. The questions evaluate the quantity of information students can comprehend and recall without the text in front of them. (b) The planet Aurea. This is an expository text consisting of 342 words. After reading it, respondents are asked to complete an outline of the text that has 22 blanks using the cloze technique: Of the 22 blanks, 5 are adjectives, 7 are nouns, 4 are verbs, etc.

Tests of Metacognition: Two tests were used to measure metacognition: the ESCOLA test (Puente, Jiménez, & Alvarado, 2009) and a Spanish adaptation of the MARSII test by Mokhtari and Reichard (2002). The ESCOLA is comprised of 56 items, each with three response alternatives, that measure the general, strategic component of metacognition, which has an underlying matrix structure (3x3) reflecting three processes (planning, supervision and evaluation), which combine with the following variables: person, task and text. The planning process has to do with the reader's previous understanding of the subject presented in the reading task, the task's objectives, and the plan of action that should be devised before starting to read. The supervision process refers to the reader's awareness of closing in on or being far from the goal proposed above, their ability to detect difficulty in the reading as they go, and having strategies available to overcome these difficulties. The evaluation process describes the results obtained after reading and to being conscious of the effectiveness of different strategies used during the reading process.

As for the variables mentioned above, the person variable reflects the reader's understanding of him or herself and of others, recognizing one's competency at performing the

reading task, being motivated, and knowing and utilizing appropriate strategies to understand what is read. The task variable involves the task's level of difficulty and ambiguity and the cognitive processes that must be activated to do the reading activity. The text variable (consider substituting context as a metacognitive variable) alludes to the text's structure and content.

The ESCOLA has been validated in Spanish-speaking populations, showing excellent psychometric properties in samples of both Spanish and Argentine students (Jiménez, Puente, Alvarado, & Arrebillaga, 2009; Puente, Jiménez, & Alvarado, 2009).

The MARSII has 30 items designed to assess readers' metacognitive awareness and the perception of strategies while they read academic materials. The test's factor structure includes the following factors: global reading strategies (GLOB), problem-solving strategies (PROB), and reading support strategies (SUP). The MARSII's global reading strategies are oriented toward global textual analysis. These problem-solving strategies are employed when the text is difficult to read. Reading support strategies refer to materials used aside from the reading that help the reader to better comprehend it. The MARSII has been designed and validated in samples of adolescents and adults in the English language; these authors are not aware of any adaptation and validation of the test for Spanish-speaking students. This meant that in order to correctly apply this test to our research, it had to first be adapted, so a study was conducted to establish its construct validity (see Appendix I). Confirmatory factor analysis revealed it to possess acceptable goodness of fit to the three-factor model proposed by the MARSII's authors (Mokhtari & Reichard, 2002).

Analysis

Comparing the Control and ADHD Groups

Our analysis of correlations indicates (see Table 1) a significant correlation ($p < .01$) between reading comprehension scores (PROLEC-SE) and performance on tests of metacognition and the components thereof. The correlation between global scores on the MARSII and ESCOLA was found to be .80. This is strong evidence for convergent validity, also supported by the high coefficients of reliability observed on the two metacognitive tests ($\alpha = .95$ for the ESCOLA and $\alpha = .93$ for the MARSII).

We compared the results of the ADHD and control groups using Student's t-test, revealing those with ADHD to perform statistically significantly lower (see Table 2) on all three tests: PROLEC-SE, $t(185) = 6.68$, $p < .01$, MARSII, $t(185) = 21.48$, $p < .01$ and ESCOLA, $t(185) = 26.50$, $p < .01$.

To assess the extent of reading deficit, evaluated by the PROLEC-SE reading comprehension test, a repeated measures Analysis of Variance was performed to determine the impact of the independent variable (control group vs. ADHD group) on the metacognition variable, which

Table 1

Correlations between Total Scores on the PROLEC, MARSÍ and ESCOLA Tests, and between the Subscales of the MARSÍ (GLOB, SUP and PROB) and the ESCOLA (Planning, Supervision, and Evaluation)

	GLOB	SUP	PROB	MARSÍ	PLAN.	SUPERV.	EVALUA.	ESCOLA
PROLEC	.387	.302	.399	.407	.384	.353	.387	.393
GLOB		.672	.842	.960	.785	.740	.749	.799
SUP			.584	.809	.479	.479	.479	.501
PROB				.908	.776	.753	.765	.802
MARSÍ					.776	.747	.755	.798
PLAN.						.858	.887	.975
SUPERV.							.838	.934
EVALUA.								.944

Note: All correlations were significant where $p < .01$

Table 2

Means, Standard Deviations (SD), and Range on the PROLEC-SE, MARSÍ and ESCOLA

Tests	Group	Mean	SD	Minimum	Maximum
PROLEC-SE	Control	62.29	13.67	35	80
	ADHD	46.02	19.20	5	80
MARSÍ	Control	99.69	15.24	64	142
	ADHD	61.06	8.33	47	103
ESCOLA	Control	78.17	8.95	46	94
	ADHD	38.67	11.31	10	79

had two levels (MARSÍ score, ESCOLA score). The variables sex, age and reading comprehension according to achievement on the PROLEC-SE were entered as covariables. The results convey that the difference in metacognition between the control and ADHD groups was statistically significant, $F(1,182) = 7.45$, $p < .01$, while none of the covariables were found to be statistically significant (sex, $F(1,182) = 2.36$, n.s., age, $F(1,182) = .952$, n.s., PROLEC-SE, $F(1,182) = .04$, n.s.). Also, no interaction was observed between group (ADHD and control) and scores on the metacognitive tests, $F(1,182) = 1.02$, n.s., or between the covariables and scores on the metacognitive tests (PROLEC-SE, $F(1,182) = .46$, n.s., Sex $F(1,182) = .49$, n.s., Age $F(1,182) = 1.13$, n.s.). Thus, once the differences in reading comprehension, sex and age were corrected, it was concluded that the groups differed significantly in metacognition.

The Scales' Prognostic Value.

The PROLEC-SE, MARSÍ and ESCOLA scales, in addition to the covariables sex and age, were evaluated using logistic regression in order to determine the different variables' capacity to correctly classify subjects into the control and ADHD groups (see Table 3).

Table 3 shows that the test with the greatest prognostic weight was the ESCOLA, followed by the MARSÍ. The rest of the covariables, including reading comprehension, did not achieve the level of statistical significance required to be considered predictors. This finding is consistent with what was observed in the analysis of covariance.

Table 4 indicates the number of cases correctly classified by the tests of metacognition (ESCOLA and MARSÍ). They yielded an excellent classification of students into the control and ADHD categories (efficacy rate of 97.3%), both in detecting true positives (sensitivity rate of 96.8%) and identifying control, or negative cases (specificity rate of 97.9%).

Analysis of Subscales

A more detailed analysis of how much each metacognitive test's subscales contributed to classification revealed that only two scales had a statistically significant prognostic value in classification: the ESCOLA's Planning scale and the MARSÍ's Problem-solving scale (PROB). Please note that the ESCOLA's Planning scale on its own obtained a satisfactory classification of students with ADHD, correctly classifying 96% of the subjects in the sample.

Table 3
Coefficients of Logistic Regression (B), Standard Error (Se), the Wald χ^2 Statistic, and Statistical Significance

TESTS	B	Se	Wald	Sig.
ESCOLA	-.155	.050	9.579	.002
MARSI	-.120	.047	6.478	.011
PROLEC-SE	-.060	.036	2.798	.094
AGE	.535	.679	.622	.430
SEX	-.344	1.383	.062	.803
Constant	16.085	8.872	3.287	.070

Table 4
Classifications Obtained by Logistic Regression Using Metacognitive Tests (ESCOLA and MARSI) as Predictors

Observed	Predicted		
	Control	ADHD	Percent Correct
Control	92	2	97.9
ADHD	3	90	96.8
Percent Correct			97.3

Table 5
Coefficients of Logistic Regression (B), Standard Error (Se), the Wald χ^2 Statistic, and Statistical Significance: Step 1 Introduces the ESCOLA Planning Subscale, Step 2 Incorporates the MARSI Problem-solving (PROB) Subscale

		B	Se	Wald	Sig.
Step 1	Planning	-.554	.102	29.47	.000
	Constant	15.672	2.992	27.437	.000
Step 2	Planning	-.463	.164	7.969	.005
	PROB	-.681	.229	8.824	.003
	Constant	3.188	9.306	10.523	.001

Table 6
Classifications Obtained by Stepwise Logistic Regression Using the ESCOLA Planning Subscale (Step 1) and Adding the MARSI Problem-solving Scale as a Predictor (Step 2)

	Observed	Predicted		
		Control	ADHD	Percent Correct
Step 1	Control	92	2	97.9
	ADHD	5	88	94.6
	Percent Correct			96.3
Step 2	Control	93	1	98.9
	ADHD	1	92	98.9
	Percent Correct			98.9

Discussion

The main result of this research was the confirmation of a close relationship between ADHD and the components of comprehension and metacognition that form part of RD. On another note, the repeated finding that there is strong comorbidity between the two disorders (August & Garfinkel, 1990; Semrud-Clikeman et al., 1992; Willcutt, Pennington, Olson, Chhabildas, & Hulslander, 2005) makes it necessary to investigate the nature of this relationship that, according to recent studies, denotes an influential genetic component (Miranda, Grau, Rosel, & Meliá, 2009; Pennington et al., 2009; Willcutt, Pennington, Olson, & DeFries, 2007), calling into question the thesis that the two disorders have different cognitive and behavioral profiles, a notion that is defended by developmental psychologists (Bonafina, Newcon, McKay, Koda, & Halperin, 2000; Felton, & Wood, 1989). According to Pennington, Groisser, and Welsh (1993), the phonological processing of children with RD is affected, while their executive functions remain intact. The reverse is the case for children with ADHD: the phonological component of reading remains intact while the executive functions are altered.

Dykman and Ackerman (1991) proposed that attention deficit with/without hyperactivity is the factor that leads those with ADHD to exhibit low achievement on reading comprehension tasks. However, these children do not perform poorly on reading tasks that involve spelling and word recognition when the phonological component is a cue (Jiménez & Ortiz, 2000). Studies of Spanish-speaking samples have yielded contradictory results with respect to the phonological component. Gómez-Betancur, Pineda and Aguirre-Acevedo (2005) concluded that children with ADHD without learning difficulties execute phonological awareness tasks similarly to control subjects. Nevertheless, Miranda, García, and Jara (2001), upon examining the development of phonological processing, reported that children with ADHD exhibit significantly lower achievement on all the measures they employed: they had more problems with speech-production, their lexical access was less efficient using a phonetic mediator, and they were less capable of using phonological information to process spoken language. The two studies' methodological differences notwithstanding, we believe an apt framework for explaining this lies in the hypotheses of Tannock and Brown (2000): (a) the phenocopy hypothesis, which posits that ADHD as a disorder is secondary to reading disability or another primary disorder, and that only secondary symptoms are present, none with profound characteristics such as, for example, cognitive or cerebral deficit and (b) the etiologic hypothesis, according to which the comorbid subgroup of ADHD + RD has a different etiology than the disorders as they occur independently of one another. It is quite possible that RD reproduces the behavioral symptoms of attention deficit with/without hyperactivity.

Bearing in mind the limitations of correlational studies, and that they do not allow one to draw causal conclusions about the results, these results highlight that some of the learning issues observed in people with ADHD may relate more to their metacognitive functions than to mere reading comprehension, given that when subjects' reading levels were equalized, those with ADHD continued to exhibit a clear deterioration in cognitive level. Furthermore, the present study has revealed sex and age, which are relevant variables to reading comprehension, to have little discriminatory power in evaluating metacognitive competency and classifying subjects as ADHD or control.

The metacognitive tests' excellent sensitivity and specificity in detecting ADHD supports our hypothesis that a determining factor of low reading achievement is, or is related to, deficit in the executive functions. These are demonstrably altered in people with ADHD as well as RD when they are faced with reading tasks requiring comprehension but not necessarily decoding, such as word identification.

The executive functions leave an important mark on metacognitive self-regulation processes: planning, supervision and evaluation. They have an equally important influence on strategic reading behavior on all the tests studied here, and on the variables: individual, task and text. The effects of the executive functions are not equally distributed across processes and variables. Our analysis of processes revealed that students performed worst on items on the scale referring to planning. This result is consistent with the theory that one of the primary responsibilities of the executive functions is to plan tasks in advance, order sequences, and establish objectives. If comprehensive reading is analogous to problem-solving, and people with ADHD exhibit poor anticipatory behavior when faced with problems like the Tower of Hanoi, their performance on reading planning tasks will also be worse. The students' results on the MARSII suggest that people with ADHD exhibit the problem-solving component of behavior very little.

One innovation of the present research was to include metacognitive scales as clinical, diagnostic instruments and draw conclusions from them about psychopedagogical intervention. The metacognition scales (e.g. ESCOLA) make two significant contributions with educational and clinical applications. The first relates to evaluation and diagnosis; they enable us to identify strong and weak aspects of metacognition directly implicated in reading, and indirectly applicable to teaching and learning. The second is of a compensatory, re-educational and restorative nature; they facilitate intervention with specific components, processes, and variables by providing directions and exercises (see Puente, Jiménez, & Alvarado, 2009). Mayor, Suengas, and González (1993) cited some typical examples and self-instructions from a metacognitive training program for hyperactive subjects designed to make the child "think

before they act” (Meichenbaum & Goodman, 1971). Other researchers have evaluated programs that facilitate maintenance and generalization in the absence of specific instructions (Kurtz & Borkowski, 1987).

One of the greatest disadvantages for students with ADHD is the impulsivity and disinhibitory behavior it entails. In other words, ADHD implies a slowed development of the ability to inhibit behavior. The executive functions related to inhibitory capacity affected by ADHD are: prolongation and memory of work, self-regulation of affect/motivation/excitement, internalization of language, analysis, and synthesis. All of the above result in the child having greater difficulty organizing his or her behavior over time, predicting and controlling behavior, and optimizing the long-term consequences of it. Though the executive functions have a neuropsychological tie to the prefrontal lobes of the brain, slowed development in the executive functions may be overcome by using metacognitive strategies, enabling one to internalize language, and to develop self-control and self-motivation. To this point, there has been scarcely any research on how to treat and manage a hyperactive child from the perspective of metacognition, or on its application as a strategy to treat the RD that usually accompanies ADHD and tends to be responsible for these students’ academic failure. This represents an emerging field of research with tremendous potential, as this study’s results suggest.

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Received February 8, 2010

Revision received September 17, 2010

Accepted October 8, 2010

APPENDIX I

CONFIRMATORY FACTOR ANALYSIS WAS USED TO VALIDATE THE SPANISH ADAPTATION OF THE MARSÍ TEST.

Sample

A sample of 150 students between the ages of 9 and 12 years-old (74 male and 76 female) completed the MARSÍ. The subjects were students with no known pathology and normal achievement for their age groups.

Results

The psychometric properties of the MARSÍ (internal consistency and factor structure) were evaluated by calculating Cronbach's alpha coefficient and by performing confirmatory factor analysis. The scales' overall internal consistency was $\alpha = .86$.

To assess the construct validity of the adapted MARSÍ, confirmatory factor analysis was carried out using AMOS 7.0. The coefficients were estimated using a ULS least squares procedure. Figure 1 presents each factor's weight, indicating the strength of association between each item and the underlying construct. The analysis revealed acceptable goodness of fit to the three-factor model proposed by the authors (Mokhtari & Reichard, 2002), with GFI (goodness of fit index) and AGFI (adjusted goodness of fit index) values over .95 and RMS (root mean square residual) $< .10$, indicating error fell within the limits of acceptability.

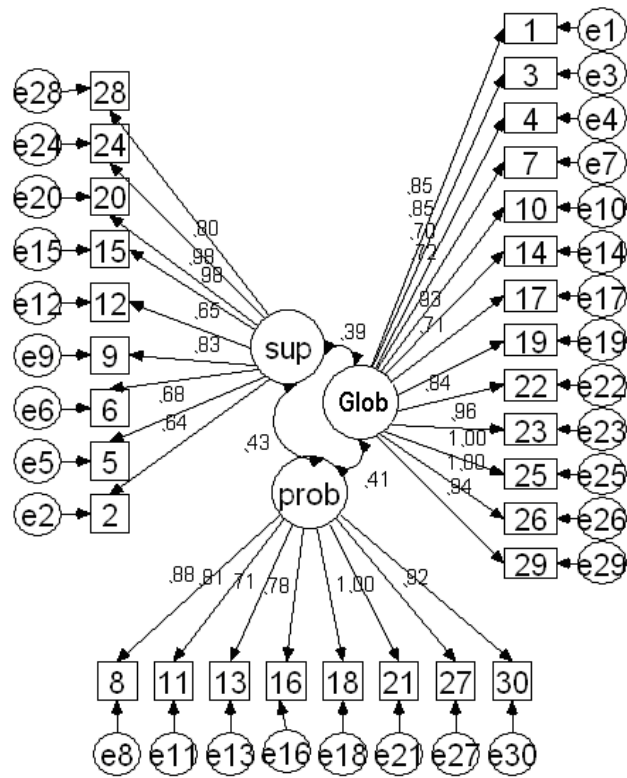


Figure 1. Factor Structure of the MARS Adapted into Spanish in 9 to 12 Year-old Students.