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# ACADEMIC SKILL PROFILES IN A SAMPLE OF MEXICAN SCHOOL CHILDREN

## *PERFILES DE HABILIDADES ACADÉMICAS EN UNA MUESTRA DE NIÑOS MEXICANOS*

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Abstract

It is important to understand learning disabilities (LD) because they are prevalent worldwide. Currently there is great controversy about LD definition, as some studies focus on the discrepancy between intelligence and academic skills, while others focus only on academic skill assessments. The DSM-IV-TR provides the most commonly used definition for LD, which includes specific learning disabilities (reading, writing, arithmetic) and unspecified learning disabilities. For specific one would expect a significant discrepancy between academic skills and IQ, in contrast, significant discrepancies should not be observed in the unspecified. The literature also reports comorbidities among LD types. The objective of this study was to evaluate reading, writing, and arithmetic task performance profiles in 127 public elementary school children. Based on DSM-IV-TR criteria, we determined academic skill profiles, the presence of LD, LD type, and potential comorbidities in our sample. Using normalized test scores for reading, writing, and arithmetic, we applied a hierarchical cluster analysis to identify academic skill patterns. The results showed the following clusters among school children: 1) children with normal academic skills (n = 80), 2) children with unspecified LD including deficiencies in all three academic processes (n = 27), and 3) children with specific reading LD including arithmetic and writing deficiencies (n = 20). These classification types may later help identify specific neuropsychological characteristics underlying a specific disability, and subsequently facilitate treatments.
*Key words:* Learning disabilities, reading disabilities, LD subtypes, hierarchical-clusters.

Resumen

Es importante comprender los problemas de aprendizaje (PA) debido a su prevalencia mundial. Actualmente existe una gran controversia respecto a la definición de los PA, ya que algunos estudios se enfocan sobre las discrepancias entre la inteligencia y las habilidades académicas, mientras otros se ocupan solo de la evaluación de las habilidades académicas. El DSM-IV-TR ofrece las definiciones de uso más común para los PA, que incluyen tanto problemas de aprendizaje específicos (lectura, escritura y aritmética), como problemas de aprendizaje no específicos.Por porblmas específicos uno podría esperar una discrepancia significativa entre habilidades académicas y el C.I., en contraste, dichas discrepancias no estarían presentes en los problemas no específicos. La literatura también reporta comorbilidades entre los tipos de PA. El objetivo de este estudio fue evaluar los perfiles de ejecución en tareas de lectura, escritura y aritmética de 127 niños de una escuela primaria pública. A partir de los criterios del DSM-IV-TR, determinamos los perfiles de habilidades académicas, la presencia de PA, su tipo, y las comorbilidades potenciales de la muestra. Empleando calificaciones normalizadas de las pruebas de lectura, escritura y aritmética, aplicamos un análisis jerárquico de cúmulos para identificar los patrones de habilidades académicas. Los resultados muestran los siguientes cúmulos entre los escolares: 1) niños con habilidades académicas normales (n = 80), 2) niños con PA no específicos que incluían deficiencias en los 3 procesos académicos (n = 27), y 3) niños con PA específicos que incluyeron deficiencias en aritmética y escritura (n = 20). Esos tipos clasificatorios pueden posteriormente ayudar a identificar características neuropsicológicas subyacentes de una discapacidad específica, y facilitar el tratamiento subsecuente.
*Palabras clave*: Problemas de aprendizaje, problemas de lectura, subtipos de problemas de aprendizaje, análisis jerárquico de cúmulos.

## Introduction

"Learning Disabilities" (LD) refers to a spectrum of reading, writing, or arithmetic deficiencies found in children. It is important to study these disorders because they are prevalent worldwide. Depending on the nature of the assessment and the specific definition, it is estimated that learning disabilities are prevalent in 2–10% of children. In the United States, approximately 5% of public school students present some form of LD. In Mexico, The Special Education General Direction reports that 10% of school-aged children require its services and that two-thirds of these children, present LD. Subsequently, these data suggest that 6–7% of the general school-age population has LD (Fletcher & Kaufman, 1995). Therefore, if there are 14,887,845 school-aged children (INEGI, 2010), and 6% of these individuals have learning disabilities, then approximately 893,271 children in Mexico have a learning disability.

There are different definitions and categories for LD. For example, some criteria focus on the discrepancy among intelligence-academic skills (American Psychiatric Association [APA], 2003; Watkin, Kush, Schaefer, 2002), while other definitions focus only on academic performance. The latter definition is often used because evidence shows that, regardless of intelligence quotient (IQ) level, children with reading retardation (without discrepancy) and students with reading disorders (with discrepancy IQ-academic skills) have similar cognitive deficits (Jiménez, Siegel and Rodrigo, 2003; Siegel, 1989).

The Diagnostic and Statistical Manual of Mental Disorders-Revised (DSM-IV-TR) (APA, 2003) includes disorders first diagnosed in infancy, childhood, or adolescence, and provides the LD definition utilized in many studies. The DSM-IV-TR LD criteria are based on strengths and weaknesses of different academic skills such that for each type of LD, the main manifestation is found in the deficiency of a specific academic skill. The manual considers that, "Exist a learning disability when the individual's performance in reading, arithmetic or written expression is substantially

below that expected for age, schooling and level of intelligence according to indicated the normalized tests applied individually". Performance that is "substantially below" is defined as a discrepancy between academic skills and IQ that is greater than 2 standard deviations.

In addition, the DSM-IV-TR divides LD into specific and unspecified categories. Criteria for a specific LD type include the following: 1) Reading learning disability, characterized by substantially lower accuracy, speed, and/or reading comprehension than the expected performance for an individual's age, IQ, and schooling, as assessed by normalized tests. 2) Mathematical disability, characterized by substantially lower arithmetic ability than the expected performance for an individual's age, IQ, and schooling, as assessed by normalized tests. 3) Written expression disability, characterized by substantially lower writing ability than the expected performance for an individual's age, IQ, and schooling, as assessed by normalized tests.

Unspecified LD includes impairments that do not satisfy the criteria of any one specific learning disability. For example, this category refers to observed deficiencies in reading, mathematics, and written expression, which may significantly interfere with academic performance even if standardized tests do not show scores that are substantially below the expected performance for an individual's age, IQ, and appropriate grade level.

Reading deficiencies are the most prevalent type of specific LD (Fletcher, Lyon, Fuchs, Barnes, 2007; Kirtley & Dennis, 2005; Stanovich, 1988) and consequently are the most commonly researched LD. The prevalence of reading disabilities is estimated between 5–17.5%, constituting the most commonly reported learning disability in American and European literature and affecting 80% of subjects identified with an LD. A theme that has been debated in this area, is if exist an unique children group, with specific Reading disability with different difficult degrees in reading, or if in fact exist children subgroups with qualitatively different characteristics (Menghini et al. 2010, Rodriguez et al., 2006). For this reason the classification, diagnostic and treatment accurate of this disability require of methods that impinge in the specific valuation of the underlying processes to the reading acquirement.

Although not considered the existence of subtypes of reading disorders, there are many neuropsychological researches that emphasize the heterogeneity of characteristics present in this type of disabilities, therefore some subtypes among specific RD children are proposed. Diverse reports in the literature conclude that children with LD are a heterogeneous group, since their deficiencies can be found in various phases of the information processing. Thus, some LD children show greater deficiencies in attention processes, others in the working memory and others at linguistic processing (Fletcher, 2009; Silva et al., 1995; Swanson & Jerman, 2010; Yáñez, 2000).

The DSM-IV-TR mentions that, "Reading disability is frequently associated with both mathematics disability and written disability, being relatively rare to find some of these in the absence of the first one". The reading disability, alone or in combination with a mathematics disability or written expression, occurs approximately in 4 of each 5 cases of Learning disability (APA, 2003).

Nonetheless, some studies are report related to each specific disabilities, in isolated or in combination. (e.g. reading/arithmetic or arithmetic/writing) (Landerl & Moll, 2010).

Individuals with LD make up an interesting diagnostic category for both clinical practice and research purposes. Unfortunately, the prevalence of learning disabilities and our understanding of specific learning impairment categories remain unclear in Latin American populations (Talero, Espinoza & Vélez, 2005). In addition, few LD comorbidity studies exist due to the focus on reading-related LD. Moreover, there is not a consistent definition for LD and some studies fail to report specific diagnostic criteria and assessment instruments, which makes it difficult to establish comparisons among studies. Therefore, this investigation aimed to assess reading, writing, and arithmetic performance profiles in Mexican public elementary school children in order to better understand LD types, prevalence, and potential comorbidity among LD subgroups.

## Method

### *Participants*

Public elementary school children (1st–6th grade) from Tlalnepantla y Tultitlán municipalities in México State participated in this study. The sample included 127 children between 7 and 12 years old (X = 9.9 years, SD ± 1.3). Boys accounted for 87.4% of participants, while girls made up 12.6% of subjects. All children presented a normal IQ (X = 100.4, SD ± 13.3) according to WISC-R, and were clinically and neurologically healthy according to a clinical-neurological evaluation by a specialist. All children came from medium-low socioeconomic levels. The participant's parents provided informed consent for their children's participation in this study.

### *Instruments*

Trained clinical psychologists administered the following instruments to all children:

1) Structured LD interview to gather pathological personal antecedents and non-pathological, heredofamilial, pre-peri and postnatal, school history, development, and emotional aspects.

2) Intelligence scale revised for school-level children (WISC-R) (Wechsler, 1981): Intelligence tests for children 6–16 years old. These tests included a verbal and execution scale and determined intelligence levels and mental retardation.

3) Neuropsychological Battery for Learning Disabilities (NBLD; Yáñez, Bernal, Harmony, Marosi, & Rodríguez, 2002). This battery evaluated cognitive functions in school-aged children (7 to 12 years) with normative data for each age group. In order to classified the children reading subtests assessed accuracy and speed of reading words (low and high frequency for real words, pseudo-words, and pseudo-homophones) and comprehension accuracy of written texts. Accuracy and speed were also measured in a writing subtest (the dictation of low and high frequency words and pseudo-words). The arithmetic subtests evaluated accuracy to dictation of numbers and accuracy in solving operations in oral and written forms. These variables were used because they are part of the classification criteria for the three specific LD subtypes.

## Design

This was a transversal and descriptive study designed to identify academic skill profiles in Mexican school-aged children.

### *Statistical analyses*

The SPSS statistical software package (version 19.0 for Windows) analyzed all data. Hierarchical conglomerate analyses included standardized scores for reading speed and writing words, reading comprehension, reading accuracy and word writing, and the accuracy of dictation of numbers and arithmetic operations for both oral and written forms.

The hierarchical conglomerates analysis was completed using Wards Method of minimum variance, with a measure of squared Euclidean distance, to identify patterns of academic skills using the neuropsychological battery. The conglomerates analysis is a classification technique that forms homogeneous groups while taking complex data into account (Borgen & Barnett, 1987).

Once conglomerates were obtained, a one-way ANOVA (analysis of variance) was conducted between groups to assess differences in academic skills (reading, writing and arithmetic) among the obtained conglomerates. The Lows Squared Differences method. (LSD) was used for post-hoc analyses.

## Results

The conglomerate analysis generated an agglomeration coefficient revealing one cut point with three solutions of conglomerates, and a visual inspection of the dendrogram confirmed this finding. The following three groups were obtained: conglomerate 1: n = 80, conglomerate 2: n = 27, and conglomerate 3: n = 20.

Table 1 shows the Z-score average and standard deviation of the conglomerate groups for each academic skill variable. Significant group differences (ANOVA results) are also reported in Table 1.

ANOVA results showed that children in conglomerate 1 were faster and more accurate at reading words, had greater success on the reading comprehension subtest, had more hits in word and number dictation, and had better oral

Table 1.
*Average Z scores (± SD) of academic skills across conglomerate groups*

| | Cluster 1 (n=80) | Cluster 2 (n=27) | Cluster 3 (n=20) | ANOVA F (p) | Post hoc (LSD) Mean differences (p) | | |
|---|---|---|---|---|---|---|---|
| | | | | [gl= 2,125] | 1vs2 | 1vs3 | 2vs3 |
| Word Reading Speed (WRS) | -0.02 (1.32) | 1.33 (1.24) | 3.06 (2.30) | 36.61 (.000)* | -1.35 (.000)* | -3.15 (.000)* | -1.80 (.000)* |
| Word Reading Accuracy (WRA) | 0.16 (0.74) | -1.63 (0.80) | -6.13 (2.83) | 271.31 (.000)* | 1.79 (.000)* | 5.79 (.000)* | 3.99 (.000)* |
| Reading Comprehension (RC) | 0.16 (1.08) | -1.03 (1.40) | -0.97 (1.32) | 13.96 (.000)* | 1.19 (.000)* | 1.13 (.000)* | -0.06 (.859) |
| Word Dictation Speed (WDS) | -0.18 (1.05) | -0.02 (0.72) | 0.55 (1.01) | 4.27 (.016)* | -0.17 (.447) | -0.73 (.004) | -0.57 (.057) |
| Word Dictation Accuracy (WDA) | 0.48 (0.74) | -0.72 (0.96) | -1.95 (1.86) | 46.43 (.000)* | 1.19 (.000)* | 2.22 (.000)* | 1.03 (.001)* |
| Number Dictation Accuracy (NDA) | 0.42 (1.15) | -1.50 (0.98) | -1.78 (1.32) | 45.38 (.000)* | 1.92 (.000)* | 2.13 (.000)* | 0.21 (.532) |
| Oral Calculation Accuracy (OCA) | 0.36 (0.82) | -1.14 (0.65) | -0.99 (1.05) | 43.89 (.000)* | 1.50 (.000)* | 1.26 (.000)* | -0.24 (.321) |
| Write Calculation Accuracy (WCA) | 0.29 (0.93) | -0.94 (0.68) | -1.19 (0.94) | 33.29 (.000)* | 1.24 (.000)* | 1.48 (.000)* | 0.24 (.365) |

Level of significance $p<0.05$

and written arithmetic operations compared to groups 2 and 3. Conglomerate 1 was also faster at word dictation compared to conglomerate 3 (see Table 1).

ANOVA findings revealed that conglomerate 2 was faster and more accurate at reading words and had more hits in word dictation compared to conglomerate 3. Although conglomerate 2 showed a marginal improvement in word reading speed compared to conglomerate 3, this result was not statistically significant (see Table 1).

Moreover, both groups of conglomerates 2 and 3 showed low scores on the reading comprehension's subtest, dictation of numbers and had low number of hits in arithmetic operations as much as in oral way as written.

## Discussion

This study identified three different academic skill profiles in school-aged children. Conglomerate 1 was the largest group (n = 80), and it presented a profile with average scores similar to those observed in children with normal academic skills. Conglomerate 2 (n = 27) presented a below average profile, with reading, writing, and arithmetic scores 1 to 2 standard deviations below normal scores. This profile reflected an

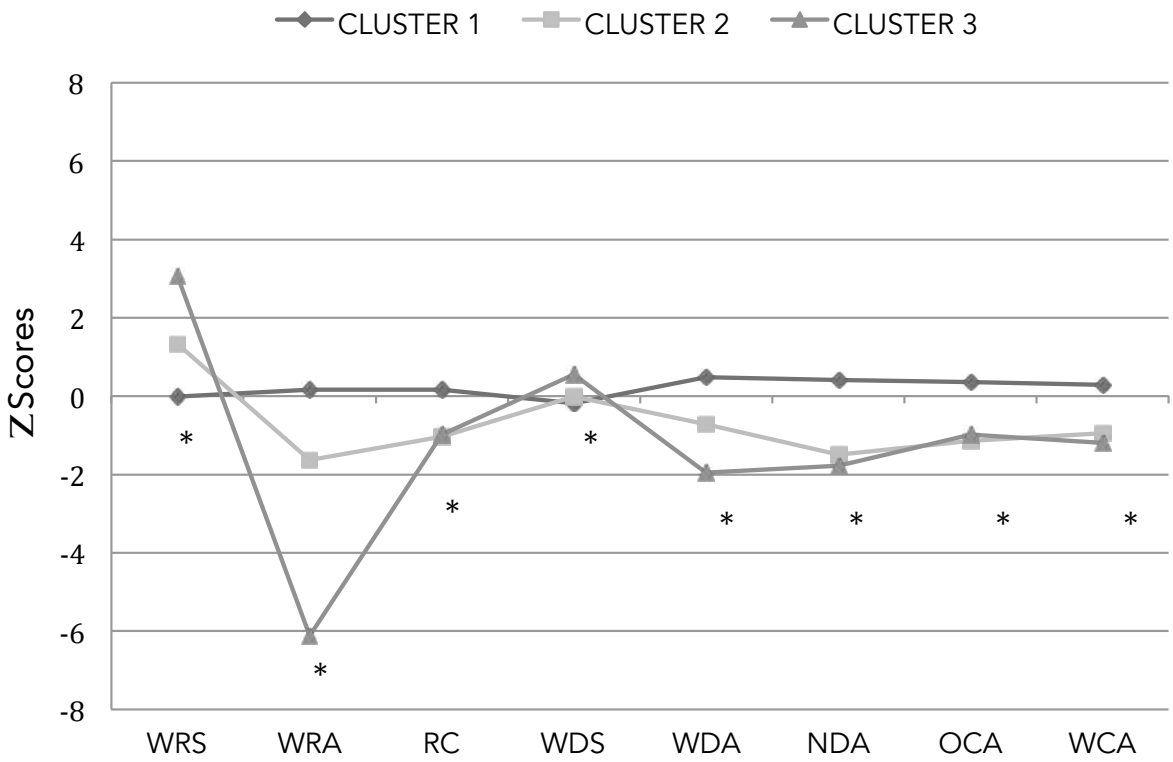


*Figure 1* shows conglomerate profiles. Conglomerate 1 reported average academic skill scores while conglomerate 2 revealed scores between 1 and 2 standard deviations below the average scores. In addition, conglomerate 3 showed speed scores and reading accuracy greater than 2 standard deviations from the mean, while writing and arithmetic scores in this group were between 1 and 2 standard deviations below average.

unspecified learning disability because there was not a substantial discrepancy between IQ and academic skills. In contrast, conglomerate 3 (n = 20) was characterized by a below average profile with speed scores and reading accuracy more than 2 standard deviations below normal scores; however reading comprehension scores, writing, and arithmetic ability were between 1 to 2 standard deviations below normal scores. This group reflected a comorbid profile of a reading learning disability with arithmetic and writing deficiencies.

Álvarez and Conde-Guzón (2009) realized a study to differentiate subtypes of children with learning disabilities using neuropsychological, cognitive and behavioral variables. They found four groups: 1) dyslexic disability, 2) generalized deficit, 3) attention deficit and 4) minimum deficit. The 1 and 2 groups are similar to those found in this study because they presented main deficiencies in reading and minimal in the other academic skills.

Our findings indicate that the NBLD subtests may distinguish children with normal academic skills from those with learning disabilities. Our results showed that of the children with LD, 57.4% had an unspecified learning disability, while 42.6% presented a comorbid reading disability with arithmetic and writing deficiencies. Our findings differ from those reported by Dirks, Spyer, van Lieshout and de Sonneville (2008), as in the present study we found arithmetic deficiencies in children who presented greater deficiencies in reading words than in reading comprehension. Prior research also shows that the main deficiency in RD children is word recognition (Soriano, 2004;

Vellutino, Fletcher, Snowling & Scanlon, 2004) rather than reading comprehension.

Fletcher et al. (2007) consider that there are several levels of LD classification: deficits in specific academic skills exist at the first level, while specific child characteristics including cognitive and subcognitive processes (e.g. deficits in phonological awareness, or rapid automatized naming, etc.) determine specific academic skill deficiencies (e.g. word recognition or reading accuracy) in the second level. Both levels are important as an adequate classification system facilitates understanding of LD nature, type, core deficits, and treatments. The present study focused on the first level of LD classification, as we described deficits in reading, writing, and arithmetic skills, not neuropsychological profiles properly.

On the other hand, all of our subjects had a normal IQ, and only one group showed a discrepancy between IQ and academic skills. These results are similar to other LD findings such that the specific reading disability particularly, seem to represent a continuous of severity in the reading difficulty more than in a dichotomous explicit category related with a cut point according to academic skills (has or has not Reading disability) (Fletcher et al., 2007; Shaywitz, 2004; Stanovich, 1988), which means differences are more qualitative than quantitative (Büttner & Hasselhorn, 2011).

These considerations are supported by results of investigations that compared the performance of children with and without IQ-academic skills discrepancy in various cognitive skills (e.g. phonological processing, or rapid automatized naming or vocabulary). These deficiencies in cognitive skills only vary in grade but are present in both groups (Hoskyn y Swanson, 2000; Restori, Katz, Lee, 2009; Stuebing et al., 2002).

According to Fletcher et al. (2007) the core deficit of a specific LD is its alteration in any academic domain (reading, writing, or mathematics). Although it is common for LD children to present alterations in more than one academic skill area, research shows that comorbidity of disabilities is most frequently observed between reading and arithmetic (Álvarez & Conde-Guzón, 2009; Fletcher, 2005; Geary, 2004; Geary & Hoard, 2001; Landerl, Fussenegger, Moll, Willburger, 2009; Vilenius-Tuohimaa, Aunola & Nurmi, 2008). For example, Geary and Hoard (2001), and Andersson (2008) and Hawort et al. (2009) suggest that reading and arithmetic disabilities are more related because they share genetic aspects, and specific deficits such as the representation and retrieval of semantic information from long term memory. However, it should be noted that other authors claim that reading and writing comorbidities are the most frequently shared disability (Defior, 2000; Landerl & Moll, 2010; Yoshimasu et al., 2012). Given that many LD children display deficiencies across several domains, it is important to evaluate all academic skill areas in order to understand an individual's strengths and weaknesses (Fletcher, Francis, Morris & Lyon, 2005).

## Conclusions

The hierarchical conglomerate analysis in school-aged children using the variables of reading, writing and arithmetic of a neuropsychological battery identified three different academic skills profiles. From these profiles, two LD groups were distinguished: a nonspecific group with reading, writing, and arithmetic deficiencies (conglomerate 2) and a specific reading-impaired group with writing and arithmetic comorbid deficiencies (conglomerate 3). It should be noted that we detected deficiency comorbidities among these three processes despite a small sample size. The first LD classification level used in this study may help identify the neuropsychological profiles, it means the specific characteristics of the cognitive affected processes, that classified children with learning disabilities. Based upon our findings, we believe that it is important to consistently evaluate a range of academic ability because omitting one skill area may mask comorbid deficiencies, which may explain the lack of consistent results found in the LD literature. Moreover, our findings may help identify groups with more homogeneous characteristics, and subsequently assist with treatment plans.

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