

## System of Diagnostic Tasks and relationship reading skill

### Sistema de Tareas Diagnósticas y la habilidad lectora

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**Abstract:** The objective of this research is to determine the relationship between the System of Diagnostic Tasks (SDT) and the reading in a sample of Cuban children in the 1st and 2nd. Three procedures were applied: (1) correlations between the SDT and the reading, (2) ANOVA of the Regression and (3) Hierarchical regression. The correlations indicated that the 17 tasks have a significant correlation with the reading in the two school grades. However, the regression ANOVA showed four cognitive tasks: Phonic analysis, Sheet ordering, Matrix solution and Quantitative relationships. In the 2nd grade, three tasks were highlighted: sheet ordering, visuo - motor coordination and problem solving. In the 1st grade, the hierarchical regression indicated the importance of phonic analysis and the ordering of plates above the others. In the 2nd grade, he indicated sheet ordering and visuo - motor coordination. In summary, phonological skills and reasoning are basic processes that underlie the acquisition of reading in the first grades.

**Key words:** reading, phonological skill, preschool, neurodevelopment

**Resumen:** La presente investigación tiene como objetivo determinar la relación entre el Sistema de Tareas Diagnósticas (STD) y la lectura en una muestra de niños cubanos en el 1º y 2º. Se aplicaron tres procedimientos: (1) correlaciones entre el STD y la lectura, (2) ANOVA de la Regresión y (3) Regresión jerárquica. Las correlaciones indicaron que las 17 tareas tienen una significativa correlación con la lectura en los dos grados escolares. Sin embargo, el ANOVA de regresión mostró cuatro tareas cognitivas: Análisis fónico, Ordenamiento de láminas, Solución de matrices y Relaciones cuantitativas. En el 2do grado, se destacaron tres tareas: Ordenamiento de láminas, Coordinación viso – motora y Solución de problemas. En el 1er grado, la Regresión jerárquica indicó la importancia de Análisis fónico y el Ordenamiento de láminas por encima de las demás. En el 2do grado, indicó Ordenamiento de láminas y la Coordinación viso – motora. En resumen, las habilidades fonológicas y el razonamiento son procesos básicos que subyacen en la adquisición de la lectura en los primeros grados escolares.

**Palabras claves:** lectura, habilidades fonológicas, preescolar, neurodesarrollo

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## Introduction

The study of reading is a subject importance at early ages because of the relationship with school success. In the educational area, reading instruction begins in the first grades, since learning to read makes it possible to learn other skills and knowledge (Pinto, Martínez, & Jiménez, 2016, Aisenberg, 2015).

The child has experience cognitive when beginning to receive school instruction in reading, basically has phonological, semantic and orthographic skills; from their experience with oral language (Fresneda, Mediavilla, & Pérez, 2017; Valdivieso, 2016). In this way, the development of language is an important prerequisite in early school to acquire reading, as the educator expects sufficient maturational conditions in the child to indicate specific and systematic instructions. However, some studies show language as an important element, but it is not the only factor to consider (Arán-Filippetti & López, 2016, Ferroni, Diuk, & Mena, 2016).

In this sense, some studies have reported the importance of working memory and processing speed (Kim & Pallante, 2012; Ziegler et al., 2010). Under the same conditions, intelligence is another function that explains the reading performance in the school stage, both the fluid intelligence (Gf or ability to solve problems without previous experience and learning) and the crystallized intelligence (Gc or wealth, breadth and depth of acquired knowledge) (Ritchie, Bates, & Plomin, 2015; Song et al., 2015).

From this perspective, researchers have reached a consensus on the preconditions that the preschool child should have to acquire reading. From develop the reading skill was need general cognitive components (intelligence, attention, memory) and specific (language) to (Cuetos et al., 2015).

Within the models of reading development, the dual route theory of Ellis and Young (1988) stands out, which has been justified by several

empirical evidences (Mosquera, 2012; Coltheart, 2006). The authors report two cognitive ways to explain the processing of the written word: the direct and the indirect. The direct path (lexical or semantic path), associates the orthographic form of the word with its internal meaning, while in the indirect path (phonological path) the graphemes of the word are related to their corresponding sounds and the meaning is accessed through of the sound of the graphemes that make it up.

Although both pathways have a strong influence on the acquisition of reading, some authors recognize the phonological path as the most important to predict the development of reading. The strong effect of the phonological route is justified by several empirical evidences: studies on dyslexia (Neuhoff et al., 2012; Gabor et al., 2011), studies on intervention to train reading (Ferroni, Mena, & Diuk, 2016) and longitudinal studies on the development of reading (Suárez-Coalla, García-de-Castro, & Cuetos, 2013). Likewise, other researchers show that the contributions of both routes are influenced by the characteristics of the language (Suárez-Coalla et al., 2013).

In this sense, cross-cultural studies inform the importance of the spelling of the language. The spelling has a remarkable influence on the speed of acquisition of the reading code. Some studies report that phonological factors would be important predictors of reading in any language (Hudson et al., 2013, Sellés, et al., 2012, Ziegler et al., 2010, Smith, 2012). However, Mosquera (2012) reports a different result in a population of Spanish-speaking children. The author reports that semantic skills predict reading performance better at 9 years than phonological strategy. The study concludes that phonological skills could have an earlier development peak where the effect is greater in the first school years and with the increase in age that effect decreases. In this way, acquiring reading in opaque languages (English, French) is more difficult than in transparent languages (Spanish, German).

Under the same conditions, the method of

teaching reading is a point to consider in the analysis. The form reading instructed has a lasting effect on the performance of children. In this way, depending on the method used, some maturing factors will acquire greater relevance than others. Jimenez and Rumeu (1989), reported that children who learned through the synthetic method had difficulties in the compression of texts, while children who learned in a global way had more errors in phoneme-grapheme coding. The same results were found by other researchers (Jiménez & Guzmán, 2003), who reported a superior effect on phonological analysis in children who learned to read through the synthetic method, however, children who learned to read by the method globally experienced greater difficulties in the naming of words when phonological mediation processes intervened. For this reason, in Cuba the two methods are used to teach literacy, since the requirement not only in the phonological separation of the word, also in word meaning.

In Cuba, the teaching of reading takes place parallel to writing, considering that both go hand in hand. From this perspective, the Cuban educational system establishes as a general objective: To develop the skills in the students that allow them to read and understand short texts of different gender and to express in writing, in simple sentences, their ideas and experiences (Díaz González, 2017).

In the first grade, Cuban education divides its instruction into two parts: preparation stage and teaching stage. The preparation stage aims to create the necessary conditions for a good learning, while the other stage is taught reading. The organization of the dressing stage is a function of the real conditions of the group and the child in particular. These conditions of development are assessed through the preschool diagnosis with the educational instrument Diagnostic Task System (STD). In this stage, the STD is important for educators because it makes it possible to design an educational strategy in the classroom, especially in the children of 1st grade.

The STD is a psychometric alternative to know the level of development in Preschool Education and to estimate forecasts in the first grades (López & Silverio, 1996). In the last ten years, Preschool Education in Cuba has used the STD as an effective instrument to guide educational strategies in this teaching. Basically, annual reports indicate oral language as the skill with the greatest difficulty in acquiring at this stage of life. However, other research highlights large numbers of preschool children with problems in verbal reasoning, behavioral inhibition, manual motor skills and spatial organization (Ramírez et al., 2015; Ramírez & Jiménez-Morales, 2014). From this perspective, the Cuban preschool child not only presents problems in the language, but also in other higher mental abilities that compromise the acquisition of basic school skills.

In this sense, the Department of Speech Therapy, at the University of Cienfuegos and the Neurosciences Institute of the Favaloro University, Argentina, carries out a group of research aimed at relating pre-school diagnosis with academic performance in the first grades (1st and 2nd grades). The line of research is important, since it indicates the main components of development to stimulate school skills from the pre-school stage, either in children with typical development for their age or in populations with special educational needs. In addition, the literature does not report studies where the scores obtained in the STD test are related to school learning.

In this sense, the present investigation intends to carry out a longitudinal study with the objective of determining the influence of STD on reading ability in the 1st and 2nd grade. The study collected the scores of the children at 5 years and then assesses those scores with the performance of the reading one year later in the 1st grade, and two years later in the 2nd grade. It is expected that the development of language has significant influence on the development of reading ability, as reported in the literature.

## Method

### Participants

The research was conducted in an educational institution in the province of Cienfuegos, Cuba. A non-probabilistic sample of intentional type was used since the selected institution is part of the Inclusive Education project of the University of Cienfuegos, Cuba. Some selection criteria were considered: a) children who attend the 1st and 2nd grades of the “Antonio Maceo” regular school from the beginning to the end of the course. b) have all the notes updated in the pre-school file. c) present the consent of the parents. Of 155 children, 143 schoolchildren participated: 68 first grade (35 females and 33 males) and 75 children in 2nd grade (39 females and 36 males). They were excluded 12 children because they do not present STD notes in their academic record.

### Description of the instrument

- *Diagnostic Task System (STD, López & Silverio, 1996)*: It is an educational instrument to assess the development of the preschool child. It is structured by 17 cognitive tasks in four areas or domains: Language, Fine motor skills, Perception and Thought. The qualification is carried out in each task through five indicators: 5 points (excellent), 4 points (good), 3 points (Regular), 2 (Bad) and 1 (Poor). In general, you can qualify in 4 ways: Profile with High Plateau (with scores between 4 and 5 points in the 17 tasks), Profile with Average Plateau (with scores of 3 in the different tests), Low Plateau Profile (with scores between 1 and 2 points) and the Inharmonic Profile (shows large variations between the scores of the 17 tasks). The 17 tasks are grouped 4 Areas: (1) Language: Phonic Analysis (PA), Pronunciation (P) and Relational Language (RL). (2) Fine motor skills: Visuo-motor coordination (VMC), Draw figure (DF), Tearing (T), Cut (C), Coloring (CO) and Draw (D). (3) Visual perception: Form (F), Similarities and differences (SD), Perceptual Organization (PO) and Fund - Figure (FF). (4) Thought: Lamina Tidy (LT), Quantitative relationships (QR), Problem solving (PS) and Matrix solution (MS).

- *Evaluative Court*: Result issued by the teacher in the basic subjects (reading) after three months of school instruction (initial evaluation cut) and at the end of the school stage (final evaluation cut).

### Procedure

In the academic record two scores were selected: (1) results in the 17 tasks obtained by the children at 5 years (independent variables), both in the group of children of 1st grade and in the group of 2nd grade, (2) performance results in the reading at the beginning and end of the grade, both in the group of children in 1st grade and in the 2nd grade group (Dependent variables).

### Statistical procedure

- Pearson coefficient with the objective of knowing the correlations between the STD variables and the performance of the reading in the initial evaluative cut and in the final evaluative cut.
- Regression ANOVA with the objective of highlighting the tasks of the STD with greater predictive weight. Dependent variable (reading performance: initial evaluative cut and evaluative cut at the end of the course) and independent variables (17 tasks of the STD).
- Hierarchical regression in order to verify the results obtained in the regression ANOVA. Dependent variable (reading performance: final evaluative cut) and independent variables (tasks of the STD with significant values in the regression ANOVA, and at the same time, with significant effect in the two moments of the evaluation: initial and final evaluation cut).

## Results

### Correlation analysis

The correlation analysis indicated significant correlations between the 17 tasks of the STD and the reading performance, both with the 1st grade evaluative cut and with the second grade evaluation cut. In general, the correlations between the variables decreased as the school grade increased.

In the first grade, the correlations between the STD and the initial evaluative cut (3 months started the course) were significant, with values between 0.50 and 0.66;  $p \leq .01$ . In the same sense, the correlations between the STD and the final evaluative cut were positive with values between 0.35 and 0.57;  $p \leq .01$  (table 1).

Table 1

*Correlation analysis between the STD and the initial and final evaluation of the reading in the 1st and 2nd grade*

	1° school year		2° school year	
	Reading (initial evaluative)	Reading (end evaluative)	Reading (initial evaluative)	Reading (end evaluative)
PA	.609(**)	.541(**)	.325(**)	.308(**)
P	.607(**)	.488(**)	.183	.159
RL	.574(**)	.518(**)	.343(**)	.375(**)
VMC	.665(**)	.428(**)	.405(**)	.402(**)
DF	.495(**)	.350(**)	.302(**)	.270(*)
T	.610(**)	.526(**)	.246(*)	.295(**)
C	.618(**)	.533(**)	.264(*)	.181
CO	.512(**)	.377(**)	.390(**)	.347(**)
D	.592(**)	.473(**)	.314(**)	.269(*)
F	.509(**)	.396(**)	.410(**)	.321(**)
SD	.543(**)	.528(**)	.299(**)	.274(*)
PO	.620(**)	.533(**)	.273(*)	.294(**)
FF	.548(**)	.492(**)	.341(**)	.345(**)
LT	.629(**)	.556(**)	.417(**)	.473(**)
QR	.610(**)	.573(**)	.146	.277(*)
PS	.589(**)	.567(**)	.350(**)	.273(*)
MS	.661(**)	.568(**)	.308(**)	.365(**)
	75	75	68	68

\*\*Level .01

\*Level .05

The analysis in the 2nd grade also showed significant correlations, although lower compared to the sample of children in 1st grade. In the initial evaluative cut, of 17 tasks only ten showed significant correlations with values between 0.29 and 0.41;  $p \leq .01$ . The tasks of C, T, PO and P did not show significant correlations. In the final evaluative cut, of 17 tasks only eight showed significant correlations with values between 0.30 and 0.47;  $p \leq .01$ . The tasks of P, DF, C, D, SD, QR, PS did not show significant correlations (see table 1).

## Regression ANOVA

The regression ANOVA indicated that in the 1st grade, eight tasks out of 17 showed significant values for predicting reading performance in the first three months of the school year: MS, VMC, PO, LT, QR, PA and P (table 2). This same analysis at the end of the course indicated that the tasks with significant values to predict were: QR, MS, PS, LT and PA (table 2). Finally, the tasks with significant values in the two moments of the evaluative cut were: MS, PA, LT and QR.

In the 2nd grade, the regression ANOVA showed five tasks of 17 with significant values to predict reading performance in the first three months: LT, F, VMC, CO and PS. While at the end of the 2nd grade assessment, only 4 tasks were highlighted: LT, VMC, RL and MS (table 2). In summary, the tasks with significant values in the two moments of the evaluative cut were: LT, VMC and MS.

Table 2

*ANOVA of regression between cognitive tasks (STD) and reading performance in two moments: initial evaluative and final evaluation of course*

Tasks	1° school year					
	Initial Evaluation (3 moth of year school)			End Evaluation (End year school)		
	R2	F	p	R2	F	p
PA	.49	23.488	.000	.33	8.861	.000
P	.54	28.103	.000	-	-	-
VMC	.56	30.185	.000	-	-	-
C	.76	78.114	.000	-	-	-
PO	.76	79.100	.000	-	-	-
LT	.67	49.597	.000	.43	13.554	.000
QR	.72	62.095	.000	.48	16.475	.000
MS	.58	32.882	.000	.39	11.262	.000
PS	-	-	-	.39	11.650	.000

Tasks	2° school year					
	Initial Evaluation (3 moth of year school)			End Evaluation (End year school)		
	R2	F	p	R2	F	p
RL	-	-	-	0.34	8.250	.000
VMC	.32	7.748	.000	0.35	8.541	.000
CO	.26	5.823	.000	-	-	-
F	.23	4.908	.001	-	-	-
LT	.20	4.172	.004	0.40	10.856	.000
PS	.17	3.408	.01	-	-	-
MS	-	-	-	0.27	6.016	.000

**Hierarchical regression analysis**

In the 1st grade, the hierarchical regression analysis indicated: Phonic Analysis (PA) and Lamina Tidy (LT) are significant predictors of reading ability.

The PA explains 37% ( $F = 43, 096; p < 0.001$ ) of the variance of the reading performance when the LT effect is controlled in the initial evaluation. Under the same conditions, LT explains 44% ( $F = 9.760; p < 0.01$ ) of the variance of the reading performance when the effect of PA is controlled (table 3). The other variables (MS and QR) did not show a significant contribution.

At the end evaluation, PA explains 29% ( $F = 30.204; p < 0.001$ ) of the variance of the reading performance. While LT explains 35% ( $F = 6,382; p < 0.5$ ) of the reading performance.

In the 2nd grade, the hierarchical regression analysis indicated: Viso - motor coordination (VMC) and Lamina Tidy (LT) are predictors of reading performance, both at the beginning of the grade and at the end of the stage.

In the first 3 months of school year, VMC task explains 16% ( $F = 12,946; p < .01$ ) of the variance of the reading performance. Under the same conditions, LT explained 22% ( $F = 4.852; p < 0.05$ ) of the variance of the reading performance (table 3).

At the end of the school year, VMC explained 16% ( $F = 12.718; p \leq .001 < .01$ ) of the variance of the reading performance, while PO explained 25% ( $F = 8.312; p \leq .005 < .01$ ).

**Discussion**

The results obtained in the STD is an important indicator to relate the development reached by the child at age 5 with the acquisition of reading skills in the 1st and 2nd grade. In this way, the development of language is not the only factor to explain the acquisition of reading.

According to the correlation analysis, all areas of development are important to explain reading in the 1st and 2nd grade. However, the regression ANOVA indicated that some have greater weight to predict.

In the first grade, the influence of PA is significant and significant, both at the beginning of learning and at the end of the grade. The result is consistent with several investigations (Arán-Filippetti & López, 2016; Ferroni, Mena, & Diuk, 2016; Ramírez & Jiménez, 2014; González et al., 2013; Escoba & Meneses, 2014, Suárez-Coalla, García-de -Castro, & Cuetos, 2013; Sellés, et al., 2012). At the beginning of the school year, phonological skills are basic to advance in the acquisition of reading, in addition, the teaching method of our context (analytical - phonic) facilitates learning from phonological skills.

However, the PA was not the only relevant variable in the 1st grade. Other tasks are highlighted as MS, LT and QR that are part of the thought domain. However, the hierarchical regression reported that LT and PA had a greater weight to explain the reading. That is, the tasks that measure the area of thought are important predictors of reading ability, although LT had a greater weight to explain it. While in the area of language PA explained with greater variance.

Table 3  
*Hierarchical regression between the cognitive tasks selected in the regression ANOVA and the reading performance*

1° school year			
Initial Evaluation (3 moth of year school)			
Model 1	R2	Changes in F	p
PA	0.37	43,096	.000
PA, OL	0.44	9,760	.003
PA, OL, RC	0.45	0,450	.505
PA, OL, SM	0.47	4,395	.040
End Evaluation (End year school)			
Model 2			
PA	.293	30.204	.000
PA, OL	.350	6.382	.014
PA, OL, RC	.365	1.681	.199
PA, OL, SM	.377	1.354	.248
2° school year			
Initial Evaluation (3 moth of year school)			
Model 3	R2	Changes in F	p
CVM	.16	12.946	.001
CVM, OL	.22	4.852	.031
End Evaluation (End year school)			
Model 4			
CVM	.16	12.718	.001
CVM, OL	.25	8.312	.005

This final result recognizes the parallel use of both strategies (phonological and semantic) in the development of reading. In this sense, insofar as one learns to coordinate the phoneme with the grapheme, the text is understood, which demands of general cognitive processes that are taxed on the semantic strategy, essentially tasks related to visual thinking. This argument is interesting, some researchers recognize the semantic strategy as a only component of language and value this function from a vocabulary task, however, it is not real. This study reports that the tasks of thinking contribute to the semantic strategy, since it makes it possible to understand the text. Consistent with this result, other studies indicate the importance of fluid intelligence, both in English-speaking children (Ritchie, et al., 2015; Song et al., 2015) and Spanish-speaking children (Ramírez, Torres, & Amor, 2016; 2017).

In the second degree, the PA does not lose prognostic value, although it decreases compared to other semantic tasks. In other words, semantic strategy in the 2nd degree and other general cognitive skills that contribute to lexical development, such as LT, PS and VMC, are relevant.

In this way, the child is more focused on understanding the text more than on learning the sounds of writing. Also in the 2nd grade, the teaching method remains the same (phonic - analytical), although with greater emphasis on compression and writing, since the child has been automating some sounds with the grapheme. At this grade level, the VMC stands out as a significant predictor, because as the child reads and understands, it is able to focus the sound graphed, or at least it is required to do so. In this way, the coordination of complex skills between motor and perception is trained, which is an indicator of the development of associative brain regions and their connectivity.

Previously, in the 1st grade, the child was oriented to relate the sound with the grapheme and to understand the text, while in 2nd grade his effort is focused on the compression and writing of the sound. Apparently the phonological variable loses predictive capacity to predict reading ability by the end of the 2nd grade, which is consistent with other authors when they perform the analysis in German children in the 2nd grade (Wimmer & Schurz, 2010) and in Cuban children in the third grade (Mosquera, 2012). This happens because the phonological skills are acquired

earlier in transparent languages and, apparently, from the 2nd grade, the child makes an effort to understand the text and the educational instruction of reading is oriented towards a global strategy.

However, the low scores in the phonological analysis, both in the 1st and 2nd grade children, are the object of alert in educators. It is recommended to carry out educational actions in a differentiated way in children with low scores in phonological analysis, both in the first three months of the school year and at the end of the course.

In summary, the results of the study have important implications in educational practice, essentially in pre-school education. The first implication is related to the predictive ability of the PA task on the reading ability in the children of 1st grade: children with low scores in the PA indicate need for immediate stimulation. Likewise, 2nd grade educators should be alert to the diagnosis of STD at the beginning of the degree: problems in phonological skills can be maintained in the 2nd grade.

The second practical implication is related to the thinking and motor fine skill tasks of the STD. Sometimes, games and the educational strategy in preschool childhood are more linguistic and to a lesser extent reasoning. In preschool childhood it is important to evaluate and stimulate the development, although in a relevant way it is recommended to value and stimulate reasoning and motor fine skills. These last skills have a significant relationship with the initial development of reading and especially with text comprehension.

Likewise, educators should consider the low scores in the VMC task, both at five years and at six years, as it reflects the maturational state of the associative brain regions. Hand - eye coordination, phoneme - grapheme and thought - language, are basic processes for acquiring reading, which could be assessed through the VMC task.

In summary, this research highlights the importance of the development of language, thinking and motor fine skills in preschool childhood to establish predictions of reading in the first grades of school. In this way, the level of development reached in preschool childhood is an important indicator to predict the future academic performance of the child, especially reading ability.

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