Identification of language disorder oriented to improve academic performance in college level

Identificación de desórdenes de lenguaje orientada a mejorar rendimiento escolar en licenciatura

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Summary. This work reports identification and definition of predictive model in order to improve academic performance using as parameters many characteristics of language disorder, executive functions and academic performance, the model is formulated with variables with higher correlations; dependent variables are: Executive Functions, dyslexia markers, RAN (Rapid Automatic Naming), non-words recognition; population was 65 students of college level; AIC (Akaike Information Criterion) technique was used to evaluate predictive models; AIC put less weight in models with a lot of variables, finally this model can be seen as a strength and weaknesses framework and a step forward to design a remedial intervention to improve academic performance; this model try to solve that more students with dyslexia are entering at college level, this proposal try to design a brief standardized instrument to detect reading disorders and use it as tool for future remedial interventions.

Keywords: Dyslexia, Remedial Intervention. Dyslexia Diagnosis.

Resumen: Se busca identificar y definir un modelo predictivo para mejorar el rendimiento escolar en licenciatura con parámetros de características de desórdenes de lenguajes, funciones ejecutivas y rendimiento escolar, se aplican test especializados en estas variables, se analizaron las variables más correlacionadas y se generó un modelo predictivo de rendimiento escolar, las variables dependientes son FE, marcadores de dislexia, la población estudiada tiene las características de que ya tiene cierta cantidad de estrategias, esto es por la edad, y por estar en licenciatura. Método se aplican test de RAN (Rapid Automatization Naming), non-words, FE, self-report, 65 estudiantes de licenciatura, Resultados el modelo que mejor ajustado con los datos (fit) es la segunda opción, no tiene que ser la que tiene más variables. Discusión se ve que tienen muy maduros las estrategias compensatorias; de las variables se tiene que influyen en el modelo son a,b,c, y las que no influyen en el modelo son d,e,f,.

Palabras Clave: Dislexia, Intervención Remedial Disléxicos, Diagnostico de Dislexia.

1 Introduction

This study proposes a college student profile in order to design a remedial intervention based on Executive Functions construct, this construct belongs to cognitive theory.

Student profile has a set of variables that are useful to detect reading disorder in students, at the end the remedial intervention proposal will work for both regular students and students with reading disorders.

In other words, the remedial intervention and diagnostic instrument are sustained by a data-based model which collect information of strengths and weaknesses from practices conducted in the remedial interventions.

In most cases the results may be limited by the fact that the best case to apply a remedial intervention of this kind must be between 5 and 7 years' old, this is, because it is the pre-reading period.

1.1 Dyslexia

Developmental dyslexia are a language disorder where individual has normal sensorial capacities and intelligence coefficient but show significant deficit in learning and reading activities [1].

Reading is the ability to orchestrate subskills among others include independent decode print and reading comprehension, is a translation from print to sound that result in text understanding [2] [3] [4] [5].

Text decoding process must be automatic, subconscious, effortless in order to left the mind free to text comprehension [4] [6] [7] [8] [9] [10].

Unless any person reaches a decoding skill mastery that make an automatic and subconscious reading, the reading process will stay in a lower level [8] [10].

1.2 Tests and Dyslexia Markers

The most reliable marker of reading process is phonologic awareness [11], but lost some of its predictive power near third year of elementary school [12], phonologic awareness is the most reliable marker in many categories, even more that many reading tests [13].

RAN (Rapid Automatic Naming) is a test and a marker of reading, applied preferably in pre-lecture phase, RAN predictive power depend in stimulus kind, that can be numbers, images, letters, using colors and objects as stimulus get a stronger marker in first degrees of elementary school.

Research findings point that dyslexia markers lost reliability power after 13 years old, this can be partly explained by the fact that dyslexic people throughout their lives develop strategies to compensate reading deficiencies, over their live dyslexic individuals show enhancement in words recognition, but their reading level remains very low [14] [15] [16] [17].

The fact is, there is not a clear factor that explain dyslexia, dyslexia behavior is the result of a complex interaction between many factor in many levels, this is better explained with Pennington multi-deficit model [18].

Pennington multi-deficit model propose that main explanation of dyslexia is the result of multiples interactions between multiples factors that has a protective function to face recognition deficiencies.

Most known deficit of dyslexia is phonological deficit or phonological awareness, although it is not sufficient to explain the heterogeneity of symptoms of dyslexic, most of cases of children with language disorder show prevalence of two or more deficits, being phonological deficit and cognitive deficit the most known dyslexic prevalence.

Several factors may affect reading development in children like variability in available reading resources, school quality, and home factors like members' behavior and members' health [19] [20].

Whatever the deficit is, appear what is known as "Matthew Effect" where any difficulty in reading process reduce their performance progressively, and the normal readers increment their reading performance progressively, this make a broader gap between normal readers and readers with deficits, this is similar with system dynamic theory where initial conditions make greater changes in future [21].

1.3 Dyslexia Identification

Dyslexia identification in early stages in most of the countries is given commonly in elementary level second level or third level [22], this is not implying any application of remedial actions

Unfortunately, at the time dyslexia was diagnosed dyslexic students already failed in many reading activities and they have a lower academic performance than their schoolmates [22].

This approach of "waiting the failure" delays applications of remedial interventions, and consequently remedial intervention are not applied in the period of time where is more effective, generally best period of time to apply is in first grade of elementary school, at this time brain usually has a high level of plasticity [22].

As might be expected, in most of cases of dyslexia nobody acts in this important stage and the chance to reduce dyslexia is lost at least partially, this situation is known as dyslexia paradox, this is the span of time between where dyslexia is addressed and the age where dyslexia is detected and treated [23].

Generally, reading disorders are treated with a reactive approach, everybody act until the reading disorder is detected, there is not a prevention approach nor pre-active approach, therefore remedial interventions are applied later in life, mostly between 8 and 12 years old in elementary school, this delay the access to effective remedial interventions that reduce academic gap and negative emotional implications.

This study was applied to college adult students; this age range has been studied very little and therefore very few developments in personalized remedial interventions.

This age group between 19 and 22 years old has another characteristic, they already have many mature compensatory methods for reading, this study report if their compensatory methods has correspondence with the framework of cognitive operations knowns as Executive Functions.

1.4 Difficult to identify dyslexia in individuals greater than 15 years' old

Dyslexia etiology models for age group between 15 and 20 years old are not truly clear, dyslexia causes cannot be clearly separated, actually main proposals include more factors in order to find significant correlations,

There is difficult to identify dyslexia in early stages because of many deficits at same time, comorbidity is very common in dyslexic people, this make hard to address symptoms and diagnosis in a reliable way.

A comorbidity pattern has been identified, while this finding is not fully quantifiable, in Pauc's (2005) [24] study did not find individuals with a single condition, the comorbidity rates are near to 95%.

Comorbidity pattern appears with high frequency in dyslexic people that suggest a condition associated to language disorders and enter in a criterion of developmental delay syndrome

As times passes, dyslexic individuals show better word recognition, although their reading performance remains slow and basically is not a smooth reading [14] [15] [16] [17].

Comorbidity of language disorders and attention deficit disorder is one of most common condition, individuals with comorbidity show a neuropsychological profile with failures in many cognitive functions that can lead to others functional deficit [25].

Most common comorbidity is dyscalculia and dyslexia, it has a combined prevalence of more than 10% and a co-occurrence around 40%, although these deficiencies have independent domains could have another shared domain [26].

Comorbidity in individuals means a co-occurrence between two or more disorders, comorbidity rates between reading disorders and neuronal disorders has high variability, average comorbidity between dyslexia and another disorder is about 40% [27].

Dyslexia borders about comorbidity are not clear, many dyslexic children comply with attention deficit and hyperactivity criteria [28] [29] [30].

Beside, frequently dyslexia have comorbidity with attention problems and motor coordination [31] [32].

Dyslexia has overlapping with pronunciation disorder [33], behavior and socio-emotional disorder [34], anxiety and depression problems as well [35].

None of comorbidities can be considered as a basic condition of dyslexia, but can complicate symptoms detections and remedial intervention application [36].

1.5 Dyslexia and Executive Function

Studies related with dyslexia and Executive Functions point that dyslexic children show deficiencies in many Executive Functions like change of activity, these activities are associated with left prefrontal cortex as well [37].

Findings about relationship between dyslexia and Executive Functions can lead to another possible approaches about treatments on dyslexia, especially for older people.

Dyslexia Rehabilitation proposal from Pasqualotto and Venuti [38], point to a combination of cognitive training, phonological awareness training and cognitive training of executive functions, they report that their proposal provide quantifiable benefits.

1.6 Related Works

Most of studies about predictive models of dyslexia and diagnosis at college level are in English language [39] [40], then many of their findings are not full generalizable to Spanish language, another observation in this domain is that including more variables to models does not increase its predictive power.

Although dyslexia are not really a visual disorder many research works about predictive model are based on eye movement pattern [41] [42].

Many research works about dyslexia predictive model measure indirectly visual recognition, like information of games on line [43].

2 Contribution

Present work reports a predictive model with 65 students' information, model use following variables: grades average, RAN, non-words recognition, planning questionnaire (7 questions), visual attention, working memory and solving problems.

RAN (Rapid Automatized Naming), is the ability to recognize many kind of pictured items like colors, letters, numbers and is a basic sub-ability of reading process.

Besides, auto-report indicates 5 persons with reading disorders, auto-report of abilities are included in Executive Functions questionnaire, questions 1 and 2.

Below we show Executive Functions questionnaire.

Questionnaire:

1 how consider yourself as a reader
1 good reader 2 poor reader 1-7 scale
2 how a parents or teacher consider you as a reader
1 good reader 2 poor reader 1-7 scale
3 do you write your goals?
4 do you rank your goals and sequences it? (sort them by priority and get done)
5 do you bold/remark begin and end activities?
6 do you update finished tasks?
7 do you graphics finished tasks?

Higher correlated variables are selected: RAN, non-words recognition, visual attention, solving problem.
Numbers in red are the higher correlations

	Escuela	ran	non-word recognition	visual attention	working memory	self report	problem
Escuela	1.000	0.8110	0.8242	0.8958	0.7159	0.5532	-0.8208
RAN		1.0000	0.7860	0.7757	0.6060	0.5169	-0.7459
Non-word recognition			1.000	0.8138	0.6879	0.4157	-0.7770
Visual attention				1.000	0.7268	0.4465	-0.7995
Working memory					1.000	0.5342	-0.6425
Self-report						1.000	-0.8335
Problem							1.000

Table. 1 Table of correlations used for model selection

AIC criteria from Hirotugu Akaike was used to evaluate models, best fit model are next.
The results are next above:

-11.47 Esc + .175 RAN + 3.819 Non-words recognition + 0.045 problem (1)

AIC stand for Akaike Information Criteria, is a mathematical model that find the best fit between model and data collected, is known because it gives more weight to models with less variables, these criteria rely on the possibility that models with more dependent variables can create a false positive.

Generated models have the higher fit with the population data, it's mean that has a higher equilibrated training.

This model configuration will be modified based on participant personal profile; this activity will be part of another future work where a remedial personalized intervention will be implemented

Running the software, 14 models gets generated, all models was evaluated with AIC method, results are showed below, first column is model ID

Model selection based on AICc

	K	AICc	Delta AICc	AICc Wt	Cum. wt	LL
3	5	26.92	0.00	0.33	0.33	-7.9
2	5	27.16	0.24	0.29	0.62	-8.02
1	6	27.95	1.04	0.19	0.81	-7.18
4	4	28.55	1.64	0.14	0.95	-9.91
7	5	32.39	5.47	0.02	0.97	-10.64
9	4	33.03	6.12	0.02	0.99	-12.15
8	4	33.91	7.00	0.01	1.00	-12.59
12	3	41.57	14.65	0.00	1.00	-17.57
6	4	48.70	21.79	0.00	1.00	-19.99
5	4	48.96	22.04	0.00	1.00	-20.11
10	4	52.69	25.78	0.00	1.00	-21.98
14	3	61.48	34.57	0.00	1.00	-27.53
13	3	63.20	36.28	0.00	1.00	-28.38
11	3	67.30	40.39	0.00	1.00	-30.44

Table. 2 Table of models, ordered by higher fit

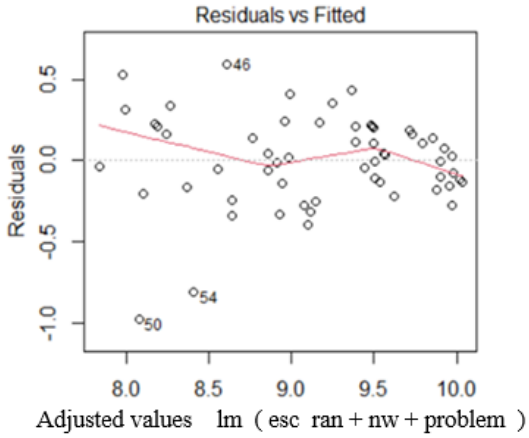

Figure 1. Graphic of errors (residuals) from Model.

Results of variables related with Executive Functions are high (Table 1), which indicates that students already had a set of cognitive matured process, results about dyslexic students match with literature, basically dyslexic had lower grades than normal readers average, and lower grades in some of Executive Functions, especially in the Executive Function know as change of activity (Shifting).

Model show some validity level because the coincidence with results of another related research work, where dyslexic show lower results than normal readers.

Results of dyslexic people about Executive Functions variables are similar with literature as well, remedial interventions with Executive Functions approach can help both cases dyslexic people and normal readers.

3 Conclusions and future works

Findings are consistent with the results of other relate studies, there's mixed results but basically very near of frontiers of significate statistics tests.

Variables with higher correlation was identified, and its weight inside the model was addressed.

After this work, we point the need of deeper analysis and newer perspectives for Executive Functions and dyslexia studies, particularly about the variable Shifting (change of activity without loss of attention), especially every functional dependency with dyslexia, in other words, identify variables that influence in more degree the remedial intervention design.

Present model did weight same way to every variable of Executive Functions, now with these findings we will give more importance to variable Shifting in future works, and take advantage of technology to make more individualized and tailored interventions.

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