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Is it possible to predict the length of therapy for developmental language impairments?

É possível prever o tempo de terapia das alterações específicas no desenvolvimento da linguagem?

ABSTRACT

Purpose: To explore which measures could predict the persistency of developmental language impairment (DLI) based on the association between the initial language assessment and the therapeutic prognosis of the child. **Methods:** In this retrospective study, the records of 42 children with diagnosis of DLI were analyzed. Participants' age varied from 21 to 63 months at the first language assessment, which included vocabulary, phonology, pragmatics and fluency tests. The performance of subjects in each test was scored from 0 to 4, based on the severity of the deficits, and the maximum score corresponded to age-adequate performance. As prognostic measure, we accounted the length of therapy (in sessions) of patients who were discharged, were referred to another service (because the deficits had become very mild), or remained in therapy (persistent language difficulties). **Results:** There was association between initial assessment (normal or mild alterations for vocabulary and pragmatics abilities) and prognosis (<135 therapeutic sessions). Vocabulary was the only variable able to predict the length of therapy. Being classified as severe in this measure caused the estimate of treatment to increase, in average, 112 sessions. **Conclusion:** The first vocabulary assessment can contribute to predict the child's therapeutic prognosis. This finding is clinically and scientifically relevant to Speech-Language Pathology, since it offers an auxiliary resource to the prognosis and therapeutic planning in cases of DLI.

RESUMO

Objetivo: Explorar quais medidas poderiam prever a persistência de alterações específicas no desenvolvimento da linguagem (AEDL) a partir da associação entre os dados do desempenho na primeira avaliação fonoaudiológica e do prognóstico terapêutico da criança. **Métodos:** Neste estudo retrospectivo, foram analisados 42 prontuários pertencentes a crianças com diagnóstico de AEDL. As idades variavam entre 21 e 63 meses no momento da primeira avaliação fonoaudiológica, que incluiu as provas de vocabulário, fonologia, pragmática e fluência. O desempenho dos sujeitos em cada prova foi pontuado de 0 a 4, com base na gravidade das alterações, sendo a pontuação máxima a adequada para a idade. Como medida prognóstica, contabilizamos o tempo de terapia (em sessões) dos pacientes que receberam alta, foram encaminhados (o quadro havia se tornado muito leve), ou permaneceram em terapia (dificuldades persistentes de linguagem). **Resultados:** Houve associação entre os dados da avaliação inicial (classificação normal ou levemente alterada no vocabulário e pragmática) e o prognóstico (<135 sessões terapêuticas). A variável referente ao vocabulário foi a única capaz de prever o tempo de terapia. A classificação como grave nesta medida aumentou, em média, 112 sessões na estimativa do tratamento. **Conclusão:** A primeira avaliação do vocabulário pode contribuir para prever o prognóstico terapêutico da criança. Este achado é de relevância clínica e científica para a Fonoaudiologia, visto que oferece um recurso auxiliar para a realização do prognóstico e planejamento terapêutico nos quadros de AEDL.

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INTRODUCTION

The early identification of risk factors for language development disorders is of great importance for diagnosis, optimization of treatment, and for the well-being of the child and his/her family. Recent studies have shown that different biologic and socio-familiar factors might be related to higher incidence of language disorders⁽¹⁻³⁾. Similarly, the child's linguistic performance in the beginning of the development has been considered an important predictor of his/hers future language abilities. Particularly, the performance in vocabulary⁽⁴⁾, language comprehension⁽⁵⁾, short-term auditory memory⁽⁶⁾, nonword repetition⁽⁷⁾, and sentence repetition⁽⁸⁾ tasks has been shown as sensitive to early identify children with developmental language impairments (DLI).

The importance of early diagnosis is mainly related to the therapeutic prognosis. The generic term "DLI" include both language delays and specific language impairments (SLI). The term is generally used in the diagnosis of children with ages bellow 5 years, because frequently these disorders can only be clearly distinguished from each other through developmental criteria⁽⁹⁾. While language delays are overcome with therapy or family counseling, SLI are persistent and may have consequences for social, affective and emotional developments. Children with SLI often present academic failure and have more risks for behavior problems, social maladjustment, depression, and victimization^(10,11); there is a significant relationship between severity of SLI and its social consequences⁽¹²⁾.

Although there have been many improvements in the early identification of DLI, little is known about the predictor factors of the prognosis of impairments already diagnosed, especially regarding the number of therapy sessions needed to overcome the language difficulties. This study had the aim to answer three questions: Is it possible to early identify distinct groups of DLI based on the initial language performance? These potential initial groups are related to the future prognosis of these children? Which measures of the initial language assessment are able to predict the prognosis of DLI?

METHODS

In this retrospective study, we analyzed the record files of 42 children who were enrolled at a specialized service for children

with language disorders at the Speech-Language Pathology and Audiology Ambulatory of the School of Medicine of the Universidade de São Paulo (USP) between the years of 2000 and 2004. Children's ages varied from 21 to 63 months old at the initial language assessment, which included tests of vocabulary, phonology, pragmatics, and fluency⁽¹³⁾. All subjects were diagnosed with DLI based on internationally described inclusion and exclusion criteria: language deficits in the absence of hearing loss, marked neurological injuries, cognitive deficits, environmental deprivation, or comprehensive emotional impairments⁽¹⁴⁻¹⁶⁾.

This study included subjects that:

- were discharged after overcoming their language deficits or reaching a developmental plateau (absence of improvement on the abilities approached in therapy throughout a year);
- were referred to a primary healthcare center or a service with specific focus on speech/phonology rehabilitation, because the deficits had become very mild;
- remained in therapy due to the persistency of language difficulties.

The length of therapy elapsed until the moment this study was carried out or until the speech-language pathology conduct was taken was used as measure of therapeutic prognosis. For this purpose, the number of 45-minute sessions carried out for each participant was accounted.

A single scoring scheme was created based on the specific analysis criteria of each test⁽¹³⁾, allowing the comparison between all studied abilities in the first assessment (Chart 1).

Data were analyzed in three steps: 1) first, cluster analyses were employed to explore whether the subjects could be assigned into different groups based on their initial assessment (initial cluster) and on their clinical development (final cluster). Afterwards, subsequent Mann-Whitney analyses were processed to identify which variables effectively contributed to clusters arrangement. For the first measures, the cluster membership of the initial cluster (the group to which each subject was assigned) was the independent variable and the performance on the tests of the initial assessment was the dependent variable. For clinical development analysis, the cluster membership of the final cluster was the independent variable, while the number of therapy sessions was the dependent variable; 2) after that, Chi-square tests were used to investigate the association between initial and final clusters, that is, to

Chart 1. Severity classification criteria for alterations in the language tests

Score	Classification	Performance in each test of the first assessment			
		Vocabulary	Phonology	Pragmatics	Fluency
0	UN	UN	UN	UN	UN
1	Severe deficits	0% - 24.9% of expected	PPTnE, PPnT and >5 IPP	0/3 IP	0/3 IF
2	Moderate deficits	25% - 44.9% of expected	PPTnE, PPnT and ≤5 IPP	1/3 IP	1/3 IF
3	Mild deficits	50% - 74.9% of expected	PPTE and PPnT, but no IPP	2/3 IP	2/3 IF
4	Adequate performance	75% - 100% of expected	PPTE	3/3 IP	3/3 IF

Note: UN = unable to perform the test due to behavior problems or linguistic inability; PPTnE = phonological processes common to typical development, but not anymore expected for the child's age; PPnT = phonological processes not common to typical development, but usually observed in phonological disorders; IPP = idiosyncratic phonological processes; PPTE = phonological processes common to typical development and still expected for the child's age; IP = adequate items in the pragmatics test (acts/min, communicative mean, communicative function); IF = adequate items in the fluency test (type of speech disruption, speech rate, frequency of disruptions)

verify whether the child's initial group was related to his/her clinical development; 3) finally, linear regression analyses were employed to identify potential predictors of the length of therapy. For analyses with hypothesis testing (Mann-Whitney, Chi-square and linear regression), it was adopted a significance level lower than 5% ($p < 0.05$).

The research protocol of this study was examined and approved by the Research Ethics Committee of this University, under the number 552/06. All parents or guardians signed a written informed consent for the participation of their child in futures studies.

RESULTS

Initially, we calculated the frequency of children classified into the different categories, in each test of the initial language assessment (Table 1). Whereas most subjects were not able to perform the fluency test, there was a huge variability of responses in the vocabulary, phonology and pragmatics tests, with high frequency of moderate and severe impairments. The mean length of therapy was 134.1 sessions ($SD = \pm 88.9$). Next, the hypotheses of this study were tested.

Cluster analyses – creating groups for the initial and final measures

For the initial cluster extraction, patients' performance in each language test of the initial assessment was considered. Given that cluster analysis does not allow the inclusion of categorical variables, it was necessary to transform the original classification on the tests (from 0 to 4) into binary variables (0 or 1). The first criterion (normal vs. impaired) did not generate satisfactory clusters due to the low quantity of children initially classified as normal (score 4) in each test. A second and more satisfactory criterion was then employed

(mild and normal vs. severe and moderate) leading to a balanced grouping of the subjects (Table 2). The Mann-Whitney test revealed that the variables that significantly contributed for the initial clusters were the vocabulary ($p < 0.001$) and the pragmatics ($p = 0.031$), but not the phonology ($p = 0.785$) and the fluency tests ($p = 0.109$).

For the final cluster formation, the variable length of therapy alone (in number of sessions) proved to be significant for differentiating the groups ($p < 0.001$). The cut off was 135 sessions (group with fewer sessions: less than 135 sessions; group with more sessions: equal to or more than 135 sessions).

After the creation of the initial and final clusters, we ran a Chi-square test to verify the association between these groups. We found association between initial and final clusters ($\chi^2 = 4.546$, $df = 1$, $p = 0.03$), indicating that the majority of the subjects classified as "mild" or "normal" in the initial vocabulary and pragmatics assessments needed fewer sessions of therapy (Figure 1).

Predicting length of therapy

In order to verify if the performance in the initial vocabulary and pragmatics tests could be considered good predictors of the length of therapy (besides only being associated to it), we ran multiple linear regression analyses. For the first regression, only the significant variables (vocabulary and pragmatics) were entered as predictors, and the length of therapy (in sessions) was the dependent variable. The regression model was significant ($F_{(1,40)} = 9.748$, $p = 0.003$), explaining 19.6% of the variance in the length of therapy. The initial vocabulary was considered a significant predictor for this regression model ($b = -77.82$, $t = -3.122$, $p = 0.003$), differently from the initial pragmatics ($b = -0.17$, $t = -1.158$, $p = 0.254$).

Because the vocabulary was the only significant variable, we ran another regression analysis with all its original categories

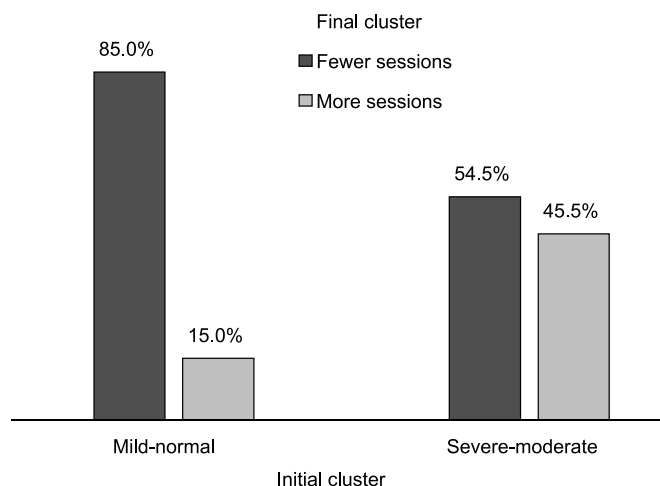
Table 1. Subjects' performance in the initial language assessment

Score	Classification	Initial language assessment			
		Vocabulary (%)	Phonology (%)	Pragmatics (%)	Fluency (%)
0	UN	---	17.1	5	97
1	Severe deficits	33.3	29.3	10	---
2	Moderate deficits	19	39	55	---
3	Mild deficits	14.3	9.8	27.5	3
4	Adequate performance	33.3	4.9	2.5	---

Note: UN = unable to perform the test due to behavior problems or linguistic inability

Table 2. Criteria for defining the binary variables in the initial cluster

	Original categories		Binary classification	n
	Score	Interpretation		
First criterion	0 to 3	Impaired	0	28
	4	Normal	1	14
Second criterion	0 to 2	Severe/moderate	0	22
	3 and 4	Mild/normal	1	20



Note: bars indicate the frequency of individuals (in percentage) assigned to each group in the initial and final clusters

Figure 1. Association between initial and final clusters

(from 0 to 4), and not only with the binary classification (0 or 1). The aim of this analysis was to precisely identify which categories of the initial vocabulary could predict the length of therapy. For this, we created dummy (dichotomous) variables regarding the score 1 (severe), 2 (moderate) and 3 (mild). The score 4 (normal) was used as the base group category for the dummies and there was no assignment for the 0 score (“unable to perform the test”) because no child receive this classification in the initial vocabulary. This latter regression model was considered better than the former ($F_{(1,40)}=23.04$, $p<0.001$), explaining 36.5% of the variance in the length of therapy. Not all the categories, however, were significant: the only predictor of the length of therapy was the classification “1” ($b=112.6$, $t=4.80$, $p<0.001$). Therefore, the severe classification on the initial vocabulary led to an average increase of 112 sessions in the estimated length of therapy, when compared to the other categories. The moderate and mild classifications, in contrast, did not significantly influence the length of therapy.

DISCUSSION

This study sought to explore the predictors of length of therapy for children with DLI. First, it was possible to identify different groups of subjects based on the initial language assessment. The variables that contributed for this grouping were initial vocabulary and pragmatics. These groups (initial clusters) were significantly associated to the length of therapy (final clusters): most children who presented better initial performance (that is, were classified as normal or with mild deficits on vocabulary and pragmatics tests) needed less therapy sessions (fewer than 135 sessions).

Finally, initial vocabulary was the only language test able to predict the length of therapy. Specifically, the severe classification on initial vocabulary was the only significant measure for the regression model, explaining 36.5% of the variance on length of therapy. According to this analysis, obtaining the classification “severe” on the first vocabulary test (equivalent to

a performance below 25% of the expected for the chronological age) might increase the estimate of length of intervention in 112 therapy sessions, in average.

Vocabulary is already considered one of the most sensitive variables to identify language disorders⁽⁴⁾. A plausible explanation for this fact is that acquiring new words involves a series of abilities that are important for linguistic development, such as auditory discrimination, phonological memory, and symbolic representation⁽¹⁷⁾. Because it condenses important abilities, vocabulary ends up constituting a sensitive measure to detect variations on language performance.

The present study showed that vocabulary not only is a sensitive measure to diagnose language disorders, but it also might be useful to predict the prognosis of the disorder. Although it does not present specificity to discriminate between clinical condition in which language is affected⁽¹⁸⁾, the performance in vocabulary tests might contribute to predict the length of therapy and, therefore, the persistency of the language deficits.

For clinical practice, this finding suggests that the performance on this test might help predicting the therapeutic prognosis for DLI as soon as in the first assessment. Children with very poor vocabulary on the initial assessment should be observed with greater caution, and deserve a more intensive therapeutic investment.

Although these findings can contribute to the early identification of persistent DLI, it is important to emphasize that the combination of other variables not explored in this study might improve the chances to a more successful prediction of the prognosis (the severity of vocabulary deficits responds for only 36.5% of the variance on length of therapy).

Further studies should explore the role of other language measures that are potential predictors of the linguistic development (e.g.: language comprehension⁽⁵⁾ and memory abilities⁽⁶⁻⁸⁾), and of biological and socio-familiar variables that, taken together, might contribute to the early identification of the severity of DLI.

CONCLUSION

This study showed that vocabulary and pragmatics were the tests that better differentiated groups of patients in the first language assessment. The main finding of this research consisted on indentifying the vocabulary measure as a significant predictor of therapy prognosis for children with DLI.

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