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Original Article

Artigo Original

Influence of the educational status on the Dichotic Sentence Identification test in Brazilian Portuguese

Influência do grau de escolaridade no teste de Identificação de Sentenças Dicóticas em Português Brasileiro

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Keywords

Hearing Tests
Auditory Cortex
Speech Discrimination Tests
Educational Status
Auditory Perception

ABSTRACT

Purpose: To compare the performance of the Dichotic Sentence Identification (DSI) test in the Brazilian Portuguese version, considering: the right and left ears and the educational status in normal-hearing individuals. **Methods:** This investigation assessed 200 individuals who are normal listeners and right-handed and were divided into seven groups according to the years of schooling. All the participants underwent basic audiologic evaluation and behavioral auditory processing assessment (sound localization test, memory test for verbal and nonverbal sounds in sequence, dichotic digits test, and DSI). **Results:** The evaluated individuals revealed an average educational status of 13.1 years and results within normal limits in the selected tests for the audiologic and auditory processing assessments. Regarding the DSI test, the educational status showed a dependent relationship with the percentages of correct answers in each stage of the test and the evaluated ear. There was a statistically significant positive correlation between the educational status and the percentage of correct answers for all the stages of the DSI test in both the ears. There was also an effect of the educational level on the results obtained in each condition of the DSI test, with the exception of directed attention to the right ear. **Conclusions:** Comparing the performance considering the variables studied in the DSI test, we concluded that there is an advantage of the right ear and that, the better the educational level, the better the performance of the individuals.

Descritores

Testes Auditivos
Córtex Auditivo
Testes de Discriminação de Fala
Escolaridade
Percepção Auditiva

RESUMO

Objetivo: Comparar o desempenho, na versão em português brasileiro, do teste de identificação de sentenças dicóticas (DSI) entre: as orelhas direita e esquerda e escolaridade em indivíduos audiologicamente normais. **Métodos:** Foram avaliados 200 indivíduos normouvintes, destros, separados em sete grupos de acordo com os anos de escolaridade.Todos os sujeitos foram submetidos à audiológica básica e comportamental do processamento auditivo (teste de localização sonora, teste de memória para sons verbais e não verbais em sequência, teste dicótico de dígitos e DSI). **Resultados:** Os sujeitos avaliados apresentaram média de escolaridade de 13,1 anos e resultados adequados nos testes selecionados para a avaliação audiológica e do processamento auditivo. Em relação ao teste DSI, a escolaridade teve relação de dependência com as porcentagens de acertos em cada etapa do teste e com a orelha avaliada. Houve correlação positiva estatisticamente significante entre a escolaridade e a porcentagem de acertos para todas as etapas do teste DSI em ambas as orelhas. Também houve efeito do grau de escolaridade nos resultados obtidos em cada etapa do teste DSI, com exceção da etapa de escuta direcionada à direita. **Conclusões:** Na comparação do desempenho considerando as variáveis estudadas no teste DSI, concluiu-se que: há vantagem da orelha direita e quanto maior o nível educacional, melhor o desempenho dos indivíduos.

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INTRODUCTION

The behavioral evaluation of the auditory processing is carried out with special hearing tests designed to infer the performance of the individuals in adverse hearing situations. The good performance in these situations may reflect the integrity of the physiological auditory mechanisms, which, in turn, are essential in the acoustic processing of the auditory information, in the perception of the speech, and in the learning and comprehension of the language[1].

The studies made to investigate the central auditory skills identified that the hearing tests may be influenced by some factors, among which the peripheral hearing loss[2-4], age[3-5], educational status and cognitive resources[6], handedness[7], sustained attention skills[8], and linguistic processing stand out.

To try to minimize the impact of some of these variables, several hearing tests were designed; among them, the Dichotic Sentences Identification (DSI) test[2]. The DSI test is a dichotic listening test of high redundancy and predictability, which was elaborated with the purpose of evaluating individuals with peripheral hearing loss. The DSI has three versions: English[2], Australian English[9], and Brazilian Portuguese[10].

The special tests are used to investigate the listening skills, and when there is a difficulty to perform these procedures, it can be said that there is an auditory processing disorder (APD). The APD can appear as a single entity or coexist with other alterations, such as learning disabilities. The impairment of learning skills is not limited to the listening skills[11].

Currently, the majority of the hearing tests that are used to assess the auditory processing have normality criteria established for age and handedness[12]. However, because the educational level can influence directly the results obtained in these tests, a careful analysis according to this variable is necessary. Thus, the aim of this study was to compare the performance in the Brazilian Portuguese version of the DSI test between: the right and left ears and the educational status in normal-hearing individuals.

METHODS

This study was analyzed and approved by the Research Ethics Committee under the process no. 0322/07 and received financial support from Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP). The participants were volunteers, recruited for the participation in the research from brochures, posting on the web and/or verbal invitation from the researchers. For the participation in the survey, the following inclusion criteria were listed: age group between 13 and 49 years old, both genders, fluent reading regardless of educational status, right-handedness (score in the hand dominance test of Edinburgh[13,14] ≥50), auditory thresholds of up to 25 dBHL in all evaluated sound frequencies (250 to 8000 Hz), type A tympanometric curve (compliance values between 0.3 and 1.6 ml and pressure peak between ±100 daPa), presence of contralateral stapedial acoustic reflexes (difference between 70 and 90 dB), adequacy in the tests of sound localization (4/5 correct answers), memory for verbal and nonverbal sounds in sequence (2/3 correct answers) and dichotic digit (≥95% of correct answers). We excluded the individuals who showed reading difficulties, score <50 points in the Edinburgh Handedness Inventory[13,14], hearing loss, alteration in the ossicular eardrum mobility and/or in the tests to assess auditory processing.

The participants were 200 individuals (adolescents and young adults), right-handed, normal listeners, matched by genre (100 men and 100 women, in the age group between 13 and 49 years old (mean age 29.7 years)), and inhabitants of the metropolitan region of São Paulo – SP.

All the individuals answered questions regarding their level of formal education and, from this information, were divided into seven groups, considering the years of schooling completed: three to seven years (n=14), eight years (n=10), nine to ten years (n=10), 11 years (n=42), 12 to 15 years (n=64), 16 years (n=36), and 17 years or more (n=24). This distribution of the groups was done according to the methodological model adopted by IBGE (Brazilian Institute of Geography and Statistics) for the Brazilian census[15].

After these procedures, the DSI[10] test was applied at 50 dBSL, in four situations: training, binaural integration, directed attention to the right ear, and directed attention to the left ear.

In all the stages of the test, the evaluated individual heard two simultaneous sentences, one in each ear. For the binaural integration stages (training and binaural integration), the individual was asked to indicate both the sentences presented. For the directed attention stages (right and left ears), the individual should just indicate the sentence presented on the ear that he or she should pay attention to.

The DSI was applied in a soundproof booth, using the following equipment: a Grason-Stadler audiometer, GSI-61 model, supra-aural headphones, TDH-50P model, and a Philips discman with MP3, Expanium model, volume 30.

For the statistical analysis of the results, we used as instruments the Minitab version 15 and the SPSS version 11 and adopted the hypothesis test with a 0.05 significance level. The results were analyzed with descriptive measures and inferential analysis (analysis of covariance and variance with repeated measures, Spearman's correlation coefficient, Kruskal-Wallis test, and Bonferroni method).

RESULTS AND DISCUSSION

The mean age of the individuals in the study was 29.7 years and mean educational status was 13.1 years. The covariance analysis, carried out at the DSI test, pointed out that the educational status showed a dependent relationship with the difference between the mean percentages of correct answers in each stage of the test (p=0.009*) and with the assessed ear (p=0.009*). There was a statistically significant positive correlation between educational status and the percentage of correct answers for all stages of the DSI test, for the right and left ears (Table 1).

The Lowess curve showed an upward configuration with steeper inclination for the left ear, and the percentages of correct

answers increased following the increasing level of schooling (Figures 1 to 3).

The difference in performance between the right and left ears in the administration of dichotic listening tests may occur because of the influence of the brainstem nuclei in the efferent regulation of other high cortical structures. During the dichotic presentation of a speech signal, the signals directed for the nondominant hemisphere are partially degraded by the circuits of the dominant hemisphere[16], thus demonstrating the existing functional hemispheric differences[17].

There was an interaction effect between the stages of the test and ear according to the educational level for the degrees of schooling of 11 years and 12 to 15 years (Table 2).

The lack of significance between the stage of the test and ear in the participants with higher educational status leads us to believe that individuals with high literacy use the resources of memory and cognitive skills more efficiently. Thus, the good perception of the speech signal, regardless of the stage of the test, would be the result of the reception, storage, and retrieval of the presented auditory information[18].

The individuals, on average, showed lower performance in the stage of training, followed by binaural integration and the directed attention stage. In addition, there was an effect, statistically significant, of the level of education on the results obtained in the training and binaural integration stages for the right and left ears and the stage of directed attention only to the left ear (Table 3).

The high performance in the directed attention stages in the dichotic listening tests, when compared with the binaural integration stage, has been reported previously[19]. The studies have shown that the difficulties observed in the stages of binaural integration, in dichotic listening tests, may occur because of the alterations in the skills of attention and/or working memory[20]. The influence of the educational status on the performance on the test was already expected because, in general, people with high educational level are in high professional positions that require extensive use of attention and other cognitive processes, and this demand in the information processing could also be reflected in the listening skills.

Although the auditory processing is extensively studied in children, adolescents and adults with auditory sensibility within normal limits and complaints in the auditory perception[1], there is a lack of studies addressing the relationship between the performance of the individuals and the educational status, especially in adults.

In the context of this gap, and observing indirect evidence on individuals with difficulties in school, learning disabilities[21], and auditory processing alterations, this study, using reference

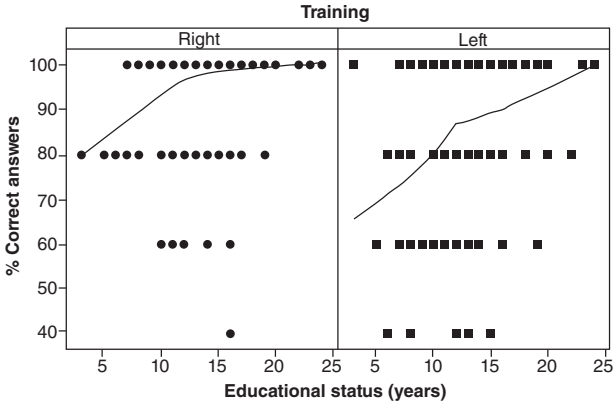

Figure 1. Diagrams of dispersion of the percentages of correct answers in training by ear and educational status

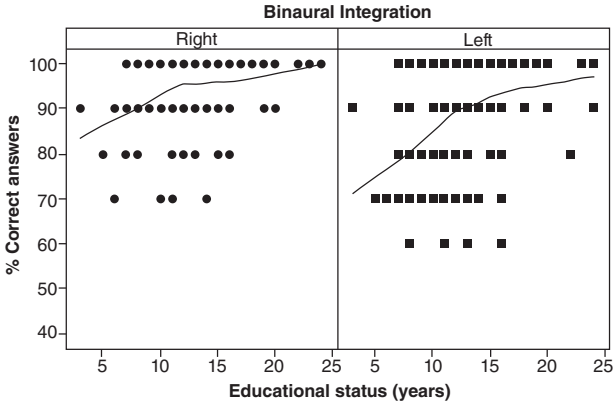

Figure 2. Diagrams of dispersion of the percentages of correct answers in binaural integration by ear and educational status

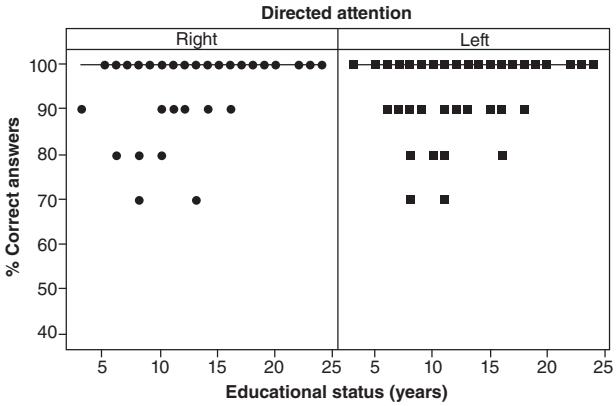

Figure 3. Diagrams of the dispersion of the percentages of correct answers in directed attention by ear and educational status

Table 1. Correlation between educational status and percentage of correct answers in the DSI test by ear

	Stage of the test					
	Training RE	Training LE	Integration RE	Integration LE	DAR	DAL
Educational status (years)						
r_s	0.29	0.31	0.28	0.37	0.20	0.17
P	0.000*	0.000*	0.000*	0.000*	0.005*	0.015*
N	200	200	200	200	200	200

r_s Spearman's rank-order correlation coefficient.
Caption: RE = right ear; LE = left ear

Table 2. P-values obtained in the comparison between the stages of the test and ears by educational status

Educational status (years)	Stage of the test	Ear	Interaction stage of the test × Ear
3–7	0.000*	0.103	0.297
8	0.000*	0.004*	0.011*
9–10	0.001*	0.188	0.465
11	0.000*	0.000*	0.020*
12–15	0.000*	0.000*	0.002*
16	0.000*	0.009*	0.232
17 or +years	0.127	0.067	0.453

ANCOVA with repeated measures.

Table 3. P values obtained in the comparison of the effects of educational status on the results by stage of the test in each ear

Stage of the Test	p-value
Training	
Right ear	0.000*
Left ear	0.000*
Integration	
Right ear	0.000*
Left ear	0.000*
Directed attention	
Right ear	0.100
Left ear	0.035*

Kruskal–Wallis test.

values designed for the DSI, from the educational status, aims to contribute to the detection of hearing disabilities in individuals with different levels of instruction and complaints of difficulty to process auditory information. Future research, with a focus on performance according to the educational status, with tests already used in clinical practice, should be carried out in order to make the behavioral assessment of the auditory processing more sensitive to detect small alterations in the processing of auditory information, even in individuals with a high degree of literacy. On the other hand, the establishment of normality criteria considering the educational status can also benefit individuals with a low level of education that may have their auditory processing assessed without the influence of this variable.

CONCLUSION

When comparing the performance considering the variables studied in the DSI test, it was possible to conclude that there is a right ear advantage and that, the higher the educational level, the better the performance of the individuals.

**ANA was responsible for elaborating the study, collection and tabulation of data, and preparing the manuscript; MRS participated in the data tabulation and preparation of the manuscript; DG and MCMI assisted in the elaboration and design of the study and in the overall orientation for the stages of implementation, supervision of the data collection, and preparation of the manuscript.*

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