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Central auditory processing: implications for the translation process from Portuguese to Brazilian Sign Language

Processamento auditivo central: implicações para o processo tradutório do Português para a Língua Brasileira de Sinais

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ABSTRACT

Purpose: To compare the influences of the results of auditory processing tests from sign language interpreters over the translation of visual/gestural speech. **Methods:** Fourteen interpreters of Brazilian sign language participated; they underwent 11 auditory processing tests and had their visual/gestural speech recorded for evaluation. The subjects were divided into two groups: G1, which consisted of seven interpreters with satisfactory levels of translation proficiency; and G2, which consisted of seven interpreters with an unsatisfactory level of translation proficiency. The candidates were selected from a philanthropic organization representative of the deaf community and sign language interpreters in Brazil via voluntary participation. For the statistical analyses, Mann-Whitney U test and the Two-Proportion Equality test were used. **Results:** The groups were compared based on the performances of their auditory processing evaluation. Differences were noticed on the Duration Pattern test and on the Non-Verbal Dichotic test, whereby G2 showed poorer performances for both tests. Furthermore, G2 reported a larger incidence of auditory processing complaints from patients, and from those with a predisposing history of disturbed auditory processing, compared to G1. **Conclusion:** G2 had poorer performance for the Non-Verbal Dichotic Pattern test and the Duration Pattern test. The results reveal that temporal and non-verbal processing of the acoustic signal, linked to the paralinguistic aspects of the speech to be interpreted, was conditional for effective comprehension of paralinguistic aspects and for the performance of the translation.

Keywords: Hearing tests; Auditory pathways; Translating; Multilingualism; Psicholinguistic

RESUMO

Objetivo: Comparar a influência dos achados da avaliação do processamento auditivo de Tradutores Intérpretes de Língua de Sinais nos seus discursos visogestuais interpretados. **Métodos:** Participaram 14 intérpretes de Língua Brasileira de Sinais (LIBRAS), submetidos a 11 testes de avaliação do processamento auditivo central (PAC) e avaliação de discurso visogestual filmado. Os sujeitos foram divididos em dois grupos: G1 – sete sujeitos com nível satisfatório de proficiência tradutória – e G2 – sete sujeitos com nível insatisfatório de proficiência tradutória. O recrutamento ocorreu por demanda espontânea, a partir de um e-mail informativo enviado a uma entidade filantrópica de grande representatividade na comunidade surda e de tradutores intérpretes de LIBRAS no Brasil. Para análise estatística, foram utilizados o teste Mann-Whitney e o teste de Igualdade de Duas Proporções. **Resultados:** Quanto à comparação de desempenho nos testes de PAC, houve diferença no teste de Padrão de Duração e no teste dicótico Não Verbal, com pior desempenho no G2, para ambos os procedimentos. Em relação às queixas de distúrbio do processamento auditivo e ao histórico predisponente de distúrbio do processamento auditivo, o G2 apresentou maior incidência, em relação ao G1. **Conclusão:** Constatou-se pior desempenho nos testes dicótico não verbal e padrão de duração no grupo com proficiência tradutória insatisfatória (G2). Os achados sugerem que o processamento temporal e não verbal do sinal acústico, vinculado aos aspectos paralinguísticos do discurso a ser interpretado, foram fatores condicionantes para a efetiva compreensão da informação e desempenho tradutório de cada grupo.

Descritores: Testes auditivos; Vias auditivas; Tradução; Multilinguismo; Psicolinguística

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INTRODUCTION

Assessing the skills involved in the profession of translation and interpretation involves focusing on the concept of bilingualism and its derivatives, as well as the possible, technical ways of implementing these processes of linguistic exchange[1,2,3].

The complexity of research focused on translation and bilingualism is surprising, and as new social paradigms arise, the necessity for updated context-dependent performances and aspects related to the profession's vocational training become warranted. Most studies involve monomodal, bilingual subjects, with oral language proficiency[4,5] and consequently, the translation and interpretation of these oral and written languages[1,2].

Such studies are standard in research. Nonetheless, recent national and international studies suggest a lack of research focusing on bimodal, bilingual subjects. Bimodal, bilingual subjects have both oral and/or written language proficiency, in addition to proficiency in sign language, thereby demonstrating linguistic proficiency in oral/auditory and visual/gestural signaling. This study assesses the oral/auditory mode of the Portuguese language, and the visual/gestural modes of Brazilian Sign Language (LIBRAS)[2,3].

In addition to refining the approaches towards unimodal and bimodal bilingualism, translation and interpretation studies should also consider the necessary skills required for interpreting from one language to another, and from one mode to another. The Sign Language Interpreter (SLI), when interpreting from an oral/auditory mode (Portuguese) to a visual/gestural mode (LIBRAS), must preserve the speech acoustic signal of the message to be interpreted[6].

Alongside a consideration of linguistic studies, a professional who must process acoustic signals in their work should carry with them an assumption of an appropriated auditory processing. Would such reasoning regarding the quality of the performance of SLI be significant and be liable to investigation?

Since the 1950s, researchers have been concerned with the lack of objective measurements for hearing that is not susceptible to analysis by peripheral hearing tests, such as pure tone audiometry (ATL) and speech recognition tests. Although the test findings were unremarkable for patients with central nervous system injuries, these results did not match the hearing complaints that they reported, especially regarding the clear perception of the subjective differences in the quality of the acoustic signal[7].

In order to facilitate a refined approach towards the development of sensitive tests in processing the characteristic features of the acoustic signal, surveys were conducted in subjects with various types of brain injury. This was allowed for the definition of neuroanatomical structures responsible for the central auditory processing of the acoustic signal studied[7]. Indeed, the tract of the auditory neural pathways involved in complex sound analysis, inappropriate response inhibition, auditory discrimination, interaural attention, and temporal regulation, as well as location and understanding of the acoustic signal was determined[8].

Central Auditory Processing (CAP) has been defined as a system of mechanisms and processes of the auditory system, for verbal and non-verbal information. It is responsible for sound lateralization and localization ability, auditory discrimination, recognition of frequency patterns, temporal aspects of hearing, temporal masking, integration and temporal ordering, auditory performance in the presence of competitive signals, and auditory performance in the presence of degraded acoustic signals[9].

In response to the initial questions, the surveys indicated that CAP skills related to other cognitive processes, such as language representation in the long-term and attentional processes. Thus, CAP was established as the system responsible for relating the various cognitive mechanisms with the acoustic signal[7].

Accordingly, CAP was defined as a process for the assimilation of environmental sound information, allowing for its transformation and integration into future behaviors[8]. This only highlights the important relationship between SLI skills and their performance of auditory function.

The literature highlights that hearing (within normal limits) facilitates the formation of internal representations, or mental images, of each sound experience and that, if there was a failure in CAP, that the mental image becomes incomplete or absent[10]. Indeed, it is possible to reflect on the relationship between the functional quality of CAP and the intelligibility of the translation.

This cyclical processing between different linguistic modes encourages reflection on the functional role played by auditory processing in the interpretation of acoustic information into visual/gestural information, owing to its imagistic visual structure.

We believe it is necessary to analyze the relationship between auditory processing and interpreted visual/gestural speech, in order to contribute towards the area of sign language translation, and its interpretation, with regard to the standardization of the diverse quality of current interpreted speeches[1]. This is because the work material, in this professional activity, also involves processing the acoustic signal (the auditory mode) into visual/gestural mode.

This study aimed at comparing the influence of the findings of the evaluation of auditory processing of Sign Language Interpreters in the interpreted visual gestural speech.

METHODS

This paper was submitted to the Research Ethics Committee of *Faculdades Metropolitanas Unidas* (FMU), with Certificate of Presentation for Ethical Consideration (CAAE) no. 15025013.6.0000.0082. All participants signed their informed consent.

This is a quantitative, cross-sectional and exploratory study, conducted in the Speech Therapy Clinical School of the

University Center of *Faculdades Metropolitanas Unidas* (FMU) (São Paulo, SP). Data collection was conducted from August to December 2013. Fourteen LIBRAS interpreters (seven females and seven males) were evaluated, the inclusion criteria being: voluntary participation in the study, and acting as a professional SLI for at least four years, given that the profession was regulated in 2010, by Federal Law no. 12.319/2010.

Interpreters were divided into two groups, according to the proficiency of their translation process from oral Portuguese to LIBRAS: Group one (G1), with a satisfactory or hardly satisfactory level of proficiency; Group two (G2), with an unsatisfactory or non-functional level of proficiency. The recruitment process occurred by voluntary participation, in which participants from a philanthropic organization representing deaf and LIBRAS interpreters' communities in Brazil were selected. The authors of the study proposed the separation of the groups according to the level of proficiency.

The proficiency assessment criteria were: 1) Semantic aspect, which included the ability to relate the connotative and denotative meanings, figures of speech, LIBRAS phonetic elements, and additions and omissions of discursive elements between the two languages; 2) Structural aspect, which included the ability to relate between the two languages in terms of the connections between narrator-narratee, narrator-character and speakers among each other, and the use of the deictic function; 3) Stylistic aspect, which included the type of speech, and included an accurate representation of the discursive, journalistic stylistic; and 4) the Cultural aspect, which included the adaptations of cultural particularities of both languages in question.

The categorization of the two groups was made from an analysis panel for the interpretation of the recorded tests focusing upon the linguistic and translation aspects of the process evaluated by a volunteer contributor, a deaf person, a fluent person, a user of LIBRAS, a graduate from Language-LIBRAS, a speech therapist, a listener, and a specialist in Brazilian Sign Language. In addition, a panel for the analysis of translation and interpretation proficiency from oral Portuguese to LIBRAS had the participation of the following panelists: a professional interpreter, a volunteer collaborator, and a speech therapist and interpreter, both of whom were listeners and specialists in LIBRAS/Portuguese translation and interpretation.

For evaluating and separating the groups, we verified, according to the speech filmed in the translation process, the presence of key elements (words, terms, expressions, agreement markers or extralinguistic components) in the excerpts from the source speech, elements, which enabled the classification of the levels of proficiency in scores: a) 0 to 6 (G2), which is an ability to discuss professional and social topics of the journalistic genre, phrasal extension, limited vocabulary, mistakes and slow to moderate signaling; and b), for scores of 7 to 10 (G1), which is an ability to establish fluid conversation at speed, and use of journalistic genre elements, large specific vocabulary, fast and accurate use of dactylology, classifiers and non-manual markers, and speech that is capable of conferring a good understanding.

To ensure adequate proficiency of the translation analysis material, we also collected material for analysis of linguistic proficiency. It was considered appropriate to collect only one visual/gestural speech to be interpreted, because the selected discursive genre (journalistic) was liable to indicate translation choices, and lexical and syntactic construction to the evaluator.

For the recording of the 5-minutes of speech used as testing material in Brazilian Sign Language, a digital camcorder, Handycam HDR-PJ10 Sony®, was used with a tripod, and was centralized in front of the interviewee positioned about 1.5 meters away, in order to record the content enunciated in LIBRAS with prior recorded guidance. The instruction was to start speaking at the verbal command of the evaluator, not to interrupt the speech during shooting, to perform these actions only in LIBRAS, and to start its conclusion only after being warned by the evaluator within the remaining 30 seconds.

For simultaneously recording interpreted visual/gestural speech, without the prior presentation of the sound material in Portuguese, we centered, in front of the interviewee, the same camera with a tripod, with the provision of guided assistance played prior to the recording of their 5-minute interpretation of oral Portuguese to LIBRAS, without interruption, until the audio had finished. The audio equipment was positioned one meter in front of the interviewee, in an acoustically treated room and in variable intensity levels of 48-63 dB HL of the oral speech to be interpreted. These data were measured by a sound level meter, MSL-1352C Minipa® model, in the same room. The message content was accompanied by the journalistic discursive genre of the translation studies, in order to ensure better audio quality on the video and in speech with the vocabulary, and the theme focused on the everyday life of the subjects.

The testing of the subjects consisted of anamnesis, visual inspection of the external auditory canal (EAC), recorded free speech, interpreted visual/gestural speech, basic audiological evaluation, and auditory processing evaluation.

For the inspection of the EAC, we used an otoscope (Klinic model, Welch Allyn®) and inserted it into the EAC to check for any changes that could prevent performing the audiological evaluation, such as the presence of earwax or obstruction. The changes observed in the visual inspection of the EAC were considered in the exclusion criterion.

The basic audiological evaluation consisted of pure tone audiometry (ATL) and speech audiometry[11]. ATL was conducted in a soundproof booth with audiometer Interacoustics®, AC 40 model and TDH 39 headphones, at sound frequencies from 250 to 8000 Hz, by the descending/ascending method. We considered normal-hearing subjects who had a tritone mean (500, 1000 and 2000 Hz) of less than, or equal to, 25 dB HL[12] Immittancemetry was made with the immittanciometer Interacoustics®, AZ7 model, consisting of the measurement of static compliance, tympanometry and analyses of the acoustic reflex.

The anamnesis consisted of the collection of personal data, educational level, specific academic training in the translation and interpretation field, and specific training in the proficiency areas of LIBRAS, hearing complaints that were reported, and the predisposing history of auditory processing disorders (APD), if available.

For the evaluation of the results of auditory processing, we used protocols elaborated by Pereira and Schochat[13], with the aid of a Sony CD player connected to the aforementioned audiometer to control the evaluation parameters.

In sequence, auditory processing tests were applied: a) low redundancy monotic auditory processing tests (Synthetic Sentence Identification Test with Competitive Message in Portuguese, SSI; and Speech-in-Noise Test, FR); b) dichotic tests (Staggered Spondaic Words test, SSW, in Portuguese; and non-verbal dichotic test, DNV); c) binaural interaction tests (Sound Localization Test); d) temporal auditory processing tests (Memory Test for Verbal and Non-verbal Sounds in Sequence; Random Gap Detection Test, RDGT; 880 -1122 Hz Frequency Pattern Test; and the 250 – 500 ms Duration Pattern Test).

The results obtained in the tests were classified as normal or altered, according to the criteria proposed by Pereira and Schochat[13] and, for discussion purposes, the following classification terms were used: non-verbal gnosis processes, decoding, encoding, and organization.

The ipsilateral SSI (monotic hearing) and contralateral (dichotic hearing) test aims at evaluating skills in grouping traces of the acoustic signal in the background, and associating auditory and visual stimuli. During application, the subject must point out, in a board of sentences, the ones that they heard. Such sentences are displayed in the presence of a competitive message (history), in relation to levels of 0 dB, -40 dB and -10 dB.

The Speech-in-Noise test aims at evaluating the ability to discriminate monosyllables in the presence of background noise. The subject is asked to repeat a list of 25 words that were physically distorted with effective white noise in monotic hearing.

The SSW test aims at evaluating the skills in grouping traces of the linguistic acoustic signal in the background and temporal ordering. In this test, the patient is evaluated for decoding, encoding, and organization gnosis impairments. During the test, the subject must recognize verbal sounds in dichotic hearing, and direct their attention to both ears to discriminate sounds in sequence. There were 160 words presented, which should be analyzed separately and together.

The DNA test aims at evaluating the skills in grouping traces of the non-linguistic acoustic signal in the background, in free and selective attentional process. It required the subject to recognize non-verbal sounds in dichotic hearing, with motor responses to point figures related to the sound stimulus, either randomly to stimuli reception sides, or sometimes in directed attention towards each ear at different times.

The evaluation of memory for verbal and non-verbal sounds in sequence involved presenting sounds of a sequence of sound instruments (bell, coconut, jingle bell and *agogô*) and of a sequence of syllables spoken by the evaluator (pah, tah, kah, fah), in isolation. Then, the individual must recognize and identify the sequence of the four sounds. After hearing each sound sequence, he must point or reproduce the order presented.

The evaluation of Sound Localization (LS) seeks to analyze the ability to locate the sound source. Such procedure is performed with a bell in the evaluator's hand, next to the subject. With eyes closed, the subject must indicate the direction in which the bell was shaken, or where he believes to be the source of the sound presented.

The RGDT addresses the temporal resolution ability. The subject must discriminate the varied intervals between stimuli presented in diotic listening. In this procedure, the individual hears nine sequences of pairs of pure tones, with intervals between 2 and 40 ms at 500 to 4000 Hz, and indicates whether he heard one or two sounds executed. From the answer, the time interval perception threshold between sounds (gap) will be obtained.

The Frequency and Duration Pattern tests[14] check the ability of the subject to discriminate sound patterns for the frequency and duration of the stimulus. During examination, the subject is asked to name stimuli after each sequence of three sounds presented. In this research, the stimuli imitation response (humming) by the subjects was not evaluated.

All tests were presented at intensity levels adequate to the average reference of pure tone thresholds in 500 Hz, 1000 Hz, and 2000 Hz frequencies. The assessment of the test results was carried out via quantitative analysis, and as for the listening status and auditory skills, they were evaluated in order to quantify tests results that were within or exceeded normal ranges. However, we performed a correlation of the findings of the CAP tests in the evaluation of the visual material recorded under the effect of proficiency analysis in LIBRAS, and translation and interpretation from oral Portuguese to LIBRAS.

Statistical methodology

Mann-Whitney U test and Two-Proportion Equality test were used. The first is a nonparametric test (used at low sampling) used in independent samples to compare the variables, always in two by two manner. The second is a nonparametric test that compares the proportion of responses of two variables, to determine the statistical significance. The p value employed was 0.10 (10%) and the statistical error was considered greater than what is generally used for analyses (5%), owing to the low sampling.

For this study, a significance level of 0.10 (10%) was considered, and is indicated in the tables by an asterisk (*). A 95% statistical confidence interval was used, placed alongside the results.

RESULTS

No differences were observed between the groups regarding age, time of professional practice, sex, education, type of education in LIBRAS and type of education in translation and interpretation (Tables 1 and 2).

No differences were found between the groups regarding the audiological variables: Auditory Processing Screening, made by means of the Sound Localization, Memory for Verbal Sounds in Sequence and Memories for Non-verbal Sounds in Sequence tests, SSW test, Speech-in-Noise test and RGDT, SSI test and Frequency Pattern.

Differences were found between the groups for the variables of APD complaint and predisposing history of APD, which, respectively, indicated a 100% prevalence of complaints in G2 (p=0.005), and a prevalence of 85.70% of predisposing history of APD (p=0.094) in G2. As for the auditory processing evaluation, the Duration Pattern and Non-Verbal Dichotic tests showed differences between the groups, because G2 presented significant changes compared to G1 (Table 3).

All percentages were always recalculated for a total of seven subjects in each group. Some variables, such as tympanometry, did not allow for comparative analysis, because there was no variability, i.e., 100% of the subjects had the same response in both groups. Thus, statistically, it was not possible to compare, but mathematically, the values were equal.

DISCUSSION

Research focused on bimodal, bilingualism has sampled subjects who were proficient in an oral-auditory language, in addition to a visual/gestural language (sign language). However, these subjects are usually hearing impaired children, immersed in auditory rehabilitation and language acquisition processes, and experienced the acquisition of two languages of their country; one as the primary language (oral-auditory) and the other as a secondary language (sign language)[2,15].

Other research into the same field has investigated normal hearing children born to deaf parents, who were sign language users, in order to analyze the influence of the mother tongue on sign language, and how this visual/gestural mode related to

Table 1. Qualitative characterization of the study sample

Variables		G1 (%) (n=7)	G2 (%) (n=7)
Sex	Female	42.90	57.10
	Male	57.10	42.90
Education level	Specialization	42.90	14.30
	Master's degree	0	14
	Complete higher education	42.90	42.90
	Incomplete higher education	14.30	28.60
Education	Formal	28.60	29
	Informal	71	71

Subtitle: G1 = Group with satisfactory proficiency; G2 = group with unsatisfactory proficiency

Table 2. Comparison of groups regarding the level of satisfaction in language and translation proficiency, age and time of practice

Variables	G1 (n=7)			G2 (n=7)		
	Mean	SD	CI	Mean	SD	CI
Age	30.1	4.6	3.4	30.4	8.1	6
Time of practice	12.4	4.1	3	8.4	4.5	3.3

Mann-Whitney U test

Subtitle: G1 = Group with satisfactory proficiency; G2 = group with unsatisfactory proficiency; SD = standard deviation; CI = confidence interval

Table 3. Comparison of groups regarding the variables related to alterations in auditory processing tests

Variáveis	n=7	G1 (%)	n=7	G2 (%)	Valor de p
Duration pattern test	0	0	5	71	0.005*
Alteration in non-verbal dichotic test	2	28.60	6	85.70	0.031*
Frequency test	3	42.90	4	57.10	0.593
SSW inversions	2	28.60	0	0	0.127
Memory for Verbal Sounds in Sequence	0	0	0	0	-
Memory for Non-verbal Sounds in Sequence	0	0	1	14.30	0.299
Sound Localization	0	0	0	0	-
Random Gap Detection Test	4	57.10	3	42.90	0.515
Staggered Spondaic Word (SSW) – Quantitative general	1	14.30	2	28.60	0.515
Order effect – High/Low	0	0	0	0	-
Auditory effect – Low/High	0	0	0	0	-
Speech-in-Noise	4	57.10	3	42.90	0.593
Sentence identification with competitive message in Portuguese – SSI	1	14.30	1	14.30	1

*Significant values (p≤0.05) – Two Proportions Equality Test

Subtitle: G1 = Group with satisfactory proficiency; G2 = group with unsatisfactory proficiency

the oral-auditory language exchanges between these subjects, specifically, and to other normal hearing individuals[3,16].

Issues related to the successively or late acquisition of adult bilingualism (acquisition of two languages in the same mode) have been widely studied as a result of an increasing of economic and social demands, since the acquisition of a second language can confer advantages in a multilingual and multicultural world. Cases of individuals who acquire a second language in adulthood, without necessarily being linked to bilingual family relations, are increasingly common and numerous[17].

Deaf people, who are users of Brazilian Sign Language, have expanded their work-related activities and increased their representation in society, thereby legitimizing the recognition of sign language as an official language. As indicated by literature reviews of linguistic studies[2,15,18], this has led to the progressive development of the Sign Language Interpreter (SLI), which is a new labor market force centered on ensuring communication accessibility to these various spheres[6].

Recently in Brazil, legislation has further structured this process, conferring legitimacy to the profession of SLI and LIBRAS as a legal and recognized language in the country[19,20,21]. As a result of these advances, the field of translation studies and other related fields, such as speech therapy, faces a new challenge in the study of this new area of research: successive bimodal, bilingual subjects, in the profession of translation and interpretation.

We believe that speech therapy, as an area responsible for the processes linked to communication, plays a potential role to researching the particularities of SLI performance as communication mediators. Sign language Interpreters, when processing from an oral-auditory mode to a visual/gestural mode, start from a context of linguistic acoustic signals that must be processed and set out in significant, visual/gestural speech.

Recent research has investigated the scope of bilingualism in the facilitation of acoustic information processing, in addition to the consideration of semantic, syntactic, morphological, and lexical cues. These studies evaluated the inputs and outputs of languages such as English, Portuguese, German, Italian and Japanese[4,5]. All had a common oral language used as a point of reference.

The present study reflects the possibility of bimodal bilingualism as also being a facilitator of acoustic information processing, owing to the presence of an oral-auditory component. While investigating SLI, we set up a scenario involving native-speakers providing: speech in their native language, enunciation in a non-native language, and processing in another mode. This raises the question as to whether or not the SLI can be more attentive to the auditory processing of their mother tongue, because of the demands of their profession that often exposes the interpreter to conferences and places with competitive noises. It is unclear if this would be considered as a limitation or as an advantage to interpreters who have Central Auditory Processing Disorder (CAPD).

The evaluation of auditory processing has its importance as individuals are constantly exposed to auditory information, which may or may not be simultaneous, and consequently, must be able to identify the information of interest, by reducing or ignoring interference that may hinder comprehension, such as competitive noise or degraded sounds. As an example, we highlight the importance of temporal, auditory processing for the syllabic discrimination of /bah/, /dah/, /gah/, /pah/, /tah/, /kah/, which were presented in a short time frame of 40 milliseconds. Individuals with temporal CAPD would have difficulty[22] differentiating between the syllables, which would become a problem for interpreters in the same scenario.

According to the results, it was observed that, although no difference was identified between G1 and G2 regarding the status of completion for their higher education, differences were evident between the groups in the areas of their specialization, and as highlighted in previous studies[1,2,6], also evident in the participants' age, time of professional practice, sex, education, type of education in LIBRAS, and type of education in translation and interpretation (Table 1). Despite the statistical differences evident between the participant cohort groups, there is potential to reflect and foster further research on speech intelligibility with respect to professional interpreters who have no academic education, or specialization.

The time of practice was not considered as a variable that could predict unsatisfactory performance in G2, since various practices and market demands, as well as the recent regulation of the profession, expose such professionals to extensive experiences, regardless of the time of practice or education. For methodological purposes, the minimum of four years of practice was considered, due to regulation of the profession having occurred in September 2010.

It was found that the answers to anamnesis related to the predisposing history of APD and APD complaints indicating significant changes in G2 (Table 3). Complaints such as difficulty in understanding the message, hesitations in speech, changes in voice perception, difficulty in formulating meaningful sentences, understanding speech in acoustically unfavorable environments, ear fullness and a lack of attention were reported by the subjects in G2, who also reported a history of recurrent otitis during childhood and the incidence of learning difficulties.

Differences were observed in the test results of both groups (Table 3). It is believed that such variables influenced the proficiency of the performances, owing to the presence of translators that only met the bare minimum score of 7 in G1. This score demonstrated a floor effect that limited the variance of G1. However, this does not entirely rule out alterations in auditory processing for some members of G1. Nonetheless, interpretations of this paper must consider the statistical power of the sample.

Research on auditory processing indicated a potential correlation between CAPD, despite the hearing thresholds remaining within the normal ranges, and normal peripheral hearing[7],

thereby supporting the data presented in this study for basic audiological evaluation of G1 and G2 groups. Additionally, despite the hearing thresholds falling within the normal criteria, the data were skewed towards the variables of communication, complaints, and a predisposing history towards CAPD.

Both groups performed well in the Auditory Processing Screening, which was conducted via Sound Localization, Memory for Verbal Sounds in Sequence, and Memory for Non-verbal Sounds in Sequence tests, for decoding, encoding, and organization. Despite alterations being evident in both groups, there was no difference. This suggested that such abilities, although important, were not decisive in the unsatisfactory proficiency of the translation process from oral/auditory mode (Portuguese) to visual/gestural mode (LIBRAS) in G2.

It also reflected whether the Auditory Processing Screening would be sensitive towards light alterations, as at the time of the examination, altered data presented in G1 and G2, or significant data between the groups were not detected, in spite of the fact that there were CAPD data presented by the individuals from both groups. This led to questionable results as screening was considered a short and simple evaluative step, which only broadly covered hearing skills in order to allow for the selection of more severe cases, compared to normality.

Differences found in the alterations of Duration Pattern and Dichotic Non-Verbal tests (Table 3) indicated an inability to analyze and interpret the non-linguistic sound patterns. The consequence of this loss can be characterized as an inability to understand the prosody of the speech signal to be interpreted, such as intonation, tone and intensity of the words[9].

This result indicated that G2 had an inability to identify the duration of sounds, the non-verbal sounds in the presence of other sounds, and the acquisition of information about the tone of the language[8,9], Such temporal aspects of speech are fundamental to understanding the information, and act as a resource linked to the processing of language subsystems, phonological aspects, and syntactic and semantic cues. Research in the field of psycholinguistics provide enough data for such findings[23,24,25,26].

The literature indicates that emphasis should be placed on paralinguistic aspects (non-verbal) and on the language pragmatics, as they facilitate the enunciation of the speaker, and allow for different interpretations of the message's meanings. Indeed, the development of research on spontaneous speech has been focused upon due to the broadening uses of communicative styles and their influence[23,24].

The psycholinguistic factors currently advocate for research using specific grammatical analyses of spoken language[24]. Temporal aspects start being meticulously analyzed and related to speech production, in addition to its effects on linguistic information[26].

Speech temporal characteristics are presented as: envelope (a term regarding the acoustic characteristics of the intensity and variation of the duration in the articulation, vocalization, discrimination and prosodic cues of speech); regularity of the acoustic signal, which varies in the presence of noise resultant from the aerodynamics of articulating phonemes; and fine--structure, regarding the variations in the acoustic signal wave format, thereby enabling for pattern analysis of articulation and vocal quality[26].

With the advances in research into CAP evaluation, it is possible to find tests that provide information on how individuals process the acoustic signal. This would enable researchers to relate it to the processing abilities of oral language, especially in the receptive context, of understanding.

Communication consists of the reception and transmission of messages, information, ideas, and/or feelings. It can be divided into: its linguistic aspects, which include speech, as well as its extralinguistic aspects, or paralinguistic elements (stress/loudness, pitch and speech intonation); non-verbal communication (gestures, facial and body language and eye contact); and metalinguistic aspects (ability to use language to analyze language)[23]. The combination of paralinguistic aspects constitutes the term oral/auditory speech prosody, which is responsible for conveying the emotional and inferential perceptions of speech that contribute largely towards speech intelligibility for the listener[24,25].

The interpreters of G1 and G2 went through a process of understanding the spoken language of the proposed audio, for five minutes. Both groups were exposed to the interpretation of the linguistic and paralinguistic content of the listened speech signal, which were aspects that were not excluded in this discussion despite its absence of eye contact or complementary gestures in the listened speech of a speaker, because them were also aspects of language, these aspects were also present[25].

The tests used to evaluate decoding (acoustic gnosis), coding (auditory gnosis) and organization (sequential gnosis) have in their composition, linguistic aspects in their protocols, such as words and phrases[8]. The findings of this study indicate that, in monotic and dichotic tasks composed of these linguistic elements, both groups performed well in understanding the explicit information.

This study indicated that for the non-verbal gnosis deficit[8], the ability to store or acquire information over time, and the ability to recognize non-verbal sounds in dichotic task, had influenced the level of proficiency in the translation and interpretation, therefore characterizing the two groups of subjects.

Despite the importance of linguistic elements, this study showed that the analysis of speech prosody is essential to understanding a message. Such finding indicates the need for research with more emphasis on qualitative data to investigate the correlation between prosodic aspects and the diversity of strategies in translation.

CONCLUSION

We found worse performance in Non-Verbal Dichotic and Duration Pattern tests in the group with unsatisfactory

translation proficiency, G2. The findings suggest that temporal and non-verbal processing of the acoustic signal, associated with paralinguistic features of the speech to be interpreted, was determinant for the effective understanding of the information and translation performance of each group.

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