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Original articles

Perception of the intelligibility and severity level of speech sound disorders by speech language pathologists and non-professionals

Percepção da inteligibilidade e gravidade do desvio fonológico por fonoaudiólogos e leigos

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ABSTRACT

Purpose: to compare the perceptual judgment of the speech intelligibility of children with speech sound disorders by speech language pathologists (men x women) and non-professionals (men x women) and to verify the agreement of the perceptual judgment with the results of the Percentage of Consonants Correct - Revised.

Methods: this research consisted of two samples: the judged and the judging. The judged sample was composed by 30 children from the Database of a clinical speech therapy, diagnosed with speech sound disorders, ages between 4:7 and 7: 11 years old (20 males and 10 females). The judging sample was composed by six speech pathologists (three males and three females) and six non-professionals (people that did not have any contact with any child), three males and three females.

Results: the judgment of intelligibility of the nonprofessionals is impaired when comparing with the intelligibility of speech language pathologists, because they have technical background in order to understand the speech of others, better judging the speech of children. Nonprofessionals agree in the same way about the severity of phonological disorder, differently of speech language pathologists, where female speech pathologists judge and agree better in the relationship of intelligibility and gravity of phonological disorder.

Conclusion: Speech Language Pathologists have greater effectiveness to judge the speech intelligibility of children that have speech sound disorders, female speech pathologists have better insight to judge the severity of speech disorders compared to the nonprofessional group, which demonstrates that more information about speech is needed.

Keywords: Speech Intelligibility; Speech Disorders; Speech Perception; Speech-Language Pathology; Child

RESUMO

Objetivo: comparar o julgamento perceptual por fonoaudiólogos(as) e leigos(as) quanto à inteligibilidade da fala de crianças com desvio fonológico, e verificar a concordância deste julgamento com a gravidade do desvio fonológico.

Métodos: a pesquisa foi composta por duas amostras: julgada e julgadora. A amostra julgada foi constituída por 30 crianças do banco de dados da clínica fonoaudiológica da instituição, com diagnóstico de desvio fonológico, na faixa etária de 4 anos e 1 mês a 7 anos e 11 meses (20 do gênero masculino e 10 do feminino). A amostra julgadora, foi composta por seis leigos, que não possuíam qualquer contato com crianças, sendo três do gênero masculino e três do feminino; e seis fonoaudiólogos, sendo três do gênero masculino e três do feminino.

Resultados: o julgamento da inteligibilidade por leigos(as) é mais prejudicado do que a inteligibilidade por fonoaudiólogos(as), pois estes possuem formação técnica para entender a fala do outro, julgando melhor a fala da criança. Leigos e leigas concordam de forma semelhante em relação à gravidade do desvio fonológico, diferentemente do grupo de fonoaudiólogos x fonoaudiólogas, onde as fonoaudiólogas julgam e concordam melhor quanto à inteligibilidade e a gravidade do desvio fonológico.

Conclusão: profissionais fonoaudiólogos(as) julgam de forma mais adequada a inteligibilidade da fala de crianças com desvio fonológico; as fonoaudiólogas possuem melhor percepção para julgar a gravidade do desvio quando comparadas aos grupos de leigos e leigas, demonstrando haver necessidade de informações a este último sobre o tema.

Descritores: Inteligibilidade da Fala; Distúrbio de Fala; Percepção da Fala; Patologia de Fala e Linguagem; Criança

INTRODUCTION

The phonological system acquisition is a gradual and non-linear process, according to the child's brain development and maturation, and to the community they are in[1-3]. This period extends from birth to approximately five years of age, when the process settles[4].

During the language acquisition, the child naturally performs phonological processes, that is, systematic simplifications of phonological rules, such as reductions or substitutions of more complex sounds. As the child develops, they stop using that strategy, and acquire the rules of adult patterns[5-7].

When the child has difficulties in arranging the sounds in their mind and adjusting the input received, and maintains phonological processes that should already have been suppressed at their age, without any apparent organic etiology, that represents a speech sound disorder[8-10]. Speech sound disorders prevail in childhood, and comprise over 70% of communication impairments. The heterogeneity of the errors that may occur in these cases makes it more difficult to learn and distinguish speech sounds correctly[11,12].

Speech sound disorders can cause great difficulties in social ties, because severity and intelligibility are correlated factors that directly influence the child's communication process. The more restricted and simplified the phonetic inventory of the child, the more unintelligible the speech[13,14].

The severity of the speech sound disorder represents to what extent the speech of the child is compromised in comparison to the adult pattern. This severity can be analyzed quantitatively by calculating the Percentage of Consonants Correct Revised (PCC-R)[15]. PCC-R generates a scale of different degrees of speech impairment according to the number of changes found, that is, the wider the changes, the greater the impairment of the phonological system, and the lower the speech intelligibility[16,17].

Intelligibility is the degree of clarity with which one's utterances are understood by most listeners [14]. In terms of speech sound disorders, the comprehension may be impaired, due to the occurrence of several phonological processes that simplify the child's production[10,18]. This aspect is quite relevant to determine when intervention is necessary, and to measure the effectiveness of therapeutic strategies[19,20].

Studies investigated the speech intelligibility of children with speech sound disorders judged by different groups[14,19,21], and their results show a strong correlation between unintelligible speech and greater severity in the judges' classification. Additionally, intelligibility is directly related to severity[19,22], because the better the judgment of intelligibility, the milder the judgment of the severity of speech sound disorder. Therefore, it is crucial to develop research on speech intelligibility in cases of speech sound disorder from the perception of different groups of judges, such as family members, teachers, doctors, speech-language pathologists, etc. According to the results that identify intelligibility between the groups, relevant information to the identification of the need for early intervention can be added, providing information to non-professionals and the child's family about the speech disorder and intelligibility. The factors involved in the therapy process can be demonstrated early on, in addition to providing guidance on the treatment planning, which may influence several settings, such as family, school and other settings familiar to the child.

Given that women are more sensitive to the development of their children, also in terms of speech, than men and non-professionals, considering those who do not have close contact with children, the hypothesis of this study is that the judgment of intelligibility by non-professionals will be worse than the judgment by speech pathologists, due to the pathologists' technical training to understand the speech of others. Therefore, speech pathologists are more likely to have a better judgment of the child's speech. It is also believed that the judgment of men (both non-professionals and speech pathologists) will be worse than that of women, either non-professionals or speech pathologists, since they are historically more sensitive to the speech of children.

Therefore, the objective of this study was to compare the perceptual judgment by speech pathologists and non-professionals in terms of speech intelligibility of children with speech sound disorders, and verify the consistency of this judgment and the severity of speech sound disorder.

METHODS

This study was conducted by means of a project approved by the Research Ethics Committee (REC) of the institution of origin and registered under No. 10/05164. Prior to the study, the judges read and signed the Informed Consent.

The research consisted of two samples, one composed by the subjects to be judged and the other composed by the judges. The subjects judged belonged to the database of the Speech Therapy

school clinic of the education institution. The sample to be judged consisted of 30 children diagnosed with speech sound disorder, aged 4:1 to 7:11, from which 20 were boys and 10 were girls. The sample of judges was composed by six non-professionals who had no daily contact with children, either in professional or home contexts. Three of these six judges were men (non-professionals) and three were women (non-professionals). It also comprised six speech pathologists, three men and three women (each group was composed by two speech pathologists specialized in audiology and one in speech/language). All judges were young adults (aged between 19 and 26), native speakers of Brazilian Portuguese (BP), selected by convenience.

The children judged were submitted to a series of phonoaudiological assessments for the diagnosis of speech sound disorders, such as evaluation of receptive and expressive language from spontaneous speech, stomatognathic system evaluation, audiological evaluation, articulation test, and phonological assessment. The data of the speech of each child were obtained by the form of the Child Language Test ABFW - Phonology[23], naming test. The data were recorded, phonetically transcribed and analyzed.

In order to verify the severity of the speech sound disorder, the contrastive analysis of the speech data was conducted based on the results of the phonological system of each child. Afterwards, the Percentage of Consonants Correct Revised (PCC-R) was calculated and analyzed[24]. Severity was classified as follows: Severe (SD), PCC-R lower than 50%; Moderate-Severe (MSD), PCC-R between 50% and 65%; Mild-Moderate (MMD), PCC-R between 65% and 85%, and Mild (MD), PCC over 85%.

After the assessments, the children's spontaneous speech was analyzed by means of a narrative with three logical sequences, consisting of three facts each, retrieved from the textbook "Nova Dimensão em Produção de Textos" (New Dimensions in Text Production)[25]. These narratives were named as "Clown" (example in Figure 1), "Ball", and "Duck" by the researchers. The stories narrated by the children were recorded and edited to leave out the researcher's interference during data collection. The samples of spontaneous speech in children's narratives were not analyzed through PCC-R, although their performance seemed to be similar to that obtained in the naming test. The standard time of all narrative recordings was 20 seconds. After editing the spontaneous narratives of the 30 children, the 90 narratives (three per child) were randomly recorded on digital media (CD), with ten seconds between each of them. The 90 narratives, recorded on CD from Speech 1 to 90, and the images presented to the children were presented to the sample of judges (six non-professionals and six speech pathologists of both genders). Additionally, the judges filled a questionnaire with identification and characterization questions and a grid for intelligibility classification. The intelligibility classifications to be judged according to the children's speech were:

1 - *Insufficient* (Unintelligible): when most words were not comprehensible and there was difficulty understanding the main topic of the message;

2 - *Fair* (*Fairly* intelligible): when it was possible to understand at least half of the words and understand the main topic of the message.

3 - *Good* (intelligible): when it was possible to understand virtually all words as well as the content of the message[14,10,21].

Figure 1. Logical sequence "Clown", presented to the children

Data analysis

The descriptive analysis of the data was conducted. In addition, the Kappa agreement analysis was conducted in order to verify the consistency between inter- and intra-group judgments in terms of intelligibility. For data analysis in terms of severity, the intermediate severities classified as moderate-severe and mild-moderate were grouped together in order to verify the intra-group agreement between severity and judgment of intelligibility. The values determined by Landis and Koch (1977) were used to interpret agreement.

RESULTS

Tables 1 and 2 show the number of judgments and the percentage of degree of intelligibility judged by non-professionals and speech pathologists, respectively. Most non-professional judges classified intelligibility as fair, whereas most speech pathologists classified it as good.

Table 3 shows the correlation analysis intra and inter-judges (speech pathologists and non-professionals). The intra-group analysis demonstrated that the agreement of female non-professionals was fair and the agreement of male non-professionals was poor. As for the group of female speech pathologists, the agreement was fair, whereas among male speech pathologists it was poor. The inter-group analysis indicated that the agreement between male non-professionals and male speech pathologists was poor. The agreement between female non-professionals and female speech pathologists was moderate. The agreement between male and female non-professionals was moderate. As for male and female speech pathologists, the agreement was poor. Thus, there was better agreement between female groups than male groups.

In terms of the severity of the speech sound disorder of the 30 children analyzed, 13 were mild, 10 mild-moderate, four moderate-severe, and three were severe. In terms of gender, most children were male, in a total of 20 boys.

The analysis of the agreement between PCC-R and the speech intelligibility judged by each group is presented in Table 5. The agreement of both female and male groups of non-professionals was fair. The group of female speech pathologists obtained Moderate agreement, that is, their judgment was closer to the degree classified by PCC-R. On the other hand, the agreement of male speech pathologists was poor.

Table 1. Intelligibility degree according to the non-professionals' judgment

Group	Intelligibility		
	Insufficient n=90 (%)	Fair n=90 (%)	Good n=90 (%)
Female non-professionals			
NP1	15 (16.7)	39 (43.3)	36 (40.0)
NP2	44 (48.9)	29 (38.3)	17 (18.9)
NP3	34 (37.8)	26 (28.9)	30 (33.3)
Total	93 (103.4)	94 (110.5)	89 (92.2)
Male non-professionals			
NP4	20 (22.2)	27 (30.0)	43 (47.7)
NP5	17 (18.8)	48 (53.3)	25 (27.7)
NP6	41 (45.5)	30 (33.3)	19 (21.1)
Total	78 (86.6)	105 (116.6)	87 (96.6)

Legend: NP = non-professionals

Table 2. Intelligibility degree according to the Speech Pathologists' judgment

Group	Intelligibility		
	Insufficient n=90 (%)	Fair n=90 (%)	Good n=90 (%)
Female Speech Pathologists			
SP1	21 (23.3)	41 (45.6)	28 (31.1)
SP2	14 (15.6)	43 (47.8)	33 (36.7)
SP3	11 (12.2)	16 (17.8)	63 (70.0)
Total	46 (51.1)	100 (111.2)	124 (137.8)
Male Speech Pathologists			
SP4	03 (3.3)	15 (16.6)	72 (80.0)
SP5	03 (3.3)	17 (18.8)	70 (77.7)
SP6	15 (16.6)	27 (30.0)	48 (53.3)
Total	21 (23.3)	59 (65.5)	190 (211.1)

Legend: SP=Speech Pathologists)

Table 3. Agreement intra e inter-judges in terms of intelligibility judgment

Subgroups	Kappa	P-value
MNP1, MNP2, MNP3	0.160	P<0.001
FNP1, FNP2, FNP3	0.293	P<0.001
MSP1, MSP2, MSP3	0.023	P= 0.321
FSP1, FSP2, FSP3	0.315	P<0.001
MNP, MSP	0.062	P=0.238
FNP, FSP	0.532	P<0.001
MNP, FNP	0.552	P<0.001
MSP, FSP	0.089	P=0.225

Legend: MNP - Male non-professionals; FNP - Female non-professionals; MSP - Male Speech Pathologists; FSP - Female Speech Pathologists.

Table 4. Characterization of the children in the study in terms of age, gender and severity of phonological disorder

Subject	Age	Gender	PCC-R (%)	Severity of phonological disorder
1	4:2	Male	31.15	S
2	4:1	Male	49.12	S
3	4:4	Male	57.26	MS
4	5:6	Male	62.25	MS
5	5:2	Female	66.21	MM
6	7:9	Female	79.68	MM
7	6:6	Male	86.50	M
8	5:11	Male	94.87	M
9	5:9	Female	91.46	M
10	5:10	Female	54.39	MS
11	6:1	Male	83.00	MM
12	8:2	Male	93.50	M
13	7:4	Male	90.78	M
14	5:6	Female	76.41	MM
15	7:11	Female	47.28	S
16	4:6	Male	70.93	MM
17	5:2	Male	84.54	MM
18	6:10	Male	64.16	MS
19	5:11	Male	88.45	M
20	4:10	Male	85.30	MM
21	4:10	Female	71.46	MM
22	7:0	Male	93.18	M
23	5:0	Female	78.72	MM
24	6:9	Male	90.21	M
25	6:5	Male	78.27	MM
26	6:10	Male	97.97	M
27	6:7	Male	92.65	M
28	5:7	Female	94.25	M
29	6:9	Female	96.36	M
30	7:1	Male	86.46	M

Legend: PCC-R - Percentage of Consonants Correct-Revised; M – Mild; MM - Mild-Moderate; MS - Moderate-severe; S – Severe.

Table 5. Agreement between judges and Percentage of Consonants Correct-Revised

Subgroups	Kappa	P-value
MNP,PCC-R	0.337	P<0.001
FNP, PCC-R	0.267	P<0.001
MSP, PCC-R	0.014	P= 0.835
FSP, PCC-R	0. 511	P<0.001

Legend: MNP - Male non-professionals; FNP - Female non-professionals; MSP - Male Speech Pathologists; FSP - Female Speech Pathologists; PCC-R - Percentage of Consonants Correct-Revised

DISCUSSION

The perceptual analysis of speech intelligibility by different populations has been used in research with children with speech sound disorders[14,19,21]. Studies demonstrate that it is important to analyze different groups of judges in terms of speech disorders, since the incidence of speech sound disorders is significantly high, and the diagnosis is often not adequate or not provided early on, which may not only impair speech, but also learning, social interactions, among others[26,27].

The findings of this study suggest that the degree of perception of intelligibility between (non-professional) men and women who do not have daily contact with children, let alone children with speech sound disorder, is similar, but women in this group agreed more, since they have sharper perceptual-auditory skills, and, thus, would be able to analyze speech in a more detailed and accurate manner [28].

Male and female non-professionals rated intelligibility according to the narratives mostly as fair, which demonstrates that they partly understood what is said by children with speech sound disorder. This is relevant because in some situations family members or people who interact with the children do not perceive speech disorders as harmful, since the disorder becomes familiar to the listener[14]. Thus, when others who are not part of the children's context or family environment perceive the speech disorders, they can act as indicators of their need for professional assistance, and it is necessary to investigate and infer speech intelligibility and perception[29].

As for male and female speech pathologists, it was possible to perceive that both groups judge the narratives' intelligibility as good. This data is due to their further contact with children, and this type of speech disorder enables a better comprehension of the children's speech. The agreement among female speech pathologists was better than among male ones, which were fair and poor, respectively. That suggests better perception by female speech pathologists.

It is also noted that male and female non-professionals had moderate agreement, higher than the agreement between male and female speech pathologists, whose level of agreement was poor. This finding reveals lack of knowledge about the subject, as male and female non-professionals had the same perceptual basis of intelligibility.

Comparing the results of the judged speech intelligibility and the severity of the speech sound disorder measured by PCC-R, it was observed that male and female non-professionals' agreement was fair. That suggests they have little contact and knowledge in terms of child's speech development, and thus judged it similarly.

Female speech pathologists obtained a higher level of agreement between their judgment and the PCC-R when compared to the corresponding male group, reaching moderate and poor levels, respectively. Despite having more homogenous training and scientific knowledge, that is believed to be due to the fact that women are more sensitive in judging children's speech [27].

The findings of this study are important because they show the need for speech pathologists to provide relevant information on cases of speech sound disorder. As a consequence, they would be acting more and more in primary care, by drawing attention to these difficulties and promoting an effective intervention at the appropriate age for diagnosis.

Given the results, the hypothesis that the judgment of intelligibility by non-professionals would be less adequate than the one by speech pathologists is confirmed, as the latter have technical training to understand others' speech and are able to judge the child's speech better. However, unlike what was expected in terms of gender, no difference was observed in the classifications of male and female non-professionals. That suggests that these groups need more information on this issue. This study is believed to raise awareness about the importance of being able to judge intelligibility in cases of speech sound disorder, mainly in terms of early detection and necessary intervention. It is suggested that speech pathologists take enlightening actions so that non-professionals from the community can recognize or perceive speech sound disorders around them. Additionally, more studies are needed in order to foster these issues scientifically.

CONCLUSION

Professional speech pathologists have greater sensitivity to judge the speech intelligibility of children with speech disorders, as both male and female groups indicated that the intelligibility of these children was good. Moreover, it is important to highlight that the group of female speech pathologists judged speech intelligibility consistently with the severity of the disorder classified by the PCC-R. The groups of non-professionals agree when it comes to judging the speech of children with disorder and its severity, as they do not have enough expertise to differentiate possible errors,

and are likely to become accustomed to the speech that is characteristic of the disorder, or do not have enough contact with them so as to distinguish typical speech to the speech characteristic of the disorder. That demonstrates the need to clarify the subject to the general population so that speech disorders are detected earlier.

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