

# PHONOLOGY, AUDITORY PROCESSING AND CHILDHOOD EDUCATION: ENVIRONMENTAL INFLUENCES ON THE DEVELOPMENT OF CHILDREN AGED FROM 4 YEARS TO 5 YEARS AND 11 MONTHS

## *Fonologia, processamento auditivo e educação infantil: influências ambientais em crianças de 4 anos a 5 anos e 11 meses*

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### ABSTRACT

**Purpose:** to describe and to analyze the phonological profile of children with ages between 4 to 5 years and 11 months attending child education institutions in the city of Belo Horizonte, to compare the phonological development of children of public and private schools and to verify the relationship between language development and resources of the family and school environments. **Methods:** the study evaluated the phonological development and auditory processing of 96 children with ages between 4 to 5 years and 11 months from three child education institutions and the school environment. **Results:** the most frequent processes were liquid simplification, cluster reduction and final consonant deletion. In the evaluation of the auditory processing, most of the children achieved satisfactory results. It was observed that children who receive less family stimulation and that attend public schools have greater chances of phonological alterations. **Conclusion:** the results of the study showed the importance of a good stimulation of the environment in which the child is inserted. Thereby it is of great importance to carry out further studies and to verify the influence of the family and school environments in the children's language development.

**KEYWORDS:** Environment; Family; Language; Speech Therapy; Child Development

### ■ INTRODUCTION

Language is a cortical function and is organized into linguistic subsystems that present interconnections<sup>1</sup>. The phonological subsystem only presents elements with signifiers, but it is essential for the organization of subsystems that present elements

with meaning (semantic, morphosyntactic and pragmatic). The phoneme is the smallest linguistic unit, simpler and more unique representative sound of the languages. Phonology is a component of the language that manages the repertoire of phonemes and organizes the way they are produced<sup>2,3</sup>. Throughout their development, the children learn to ignore some phonemes and keep attention to those that are most used in their mother tongue<sup>4</sup>. In the normal acquisition process, the domain of the phonemes of the target language occurs spontaneously in a sequence and age group common to most of the children (four to six years old)<sup>5</sup>.

The phonological processes are present and they are characterized by systematic changes that interfere in a class or sequence of sounds; these changes occur regularly in the children's speech in order to simplify the target sound already produced

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by adults<sup>6</sup>. The phonological processes that are part of the typical phonological development are: syllable reduction, consonant harmony, fricative plosivation, velar backing, palatal backing, velar fronting, palatal fronting, liquid simplification, cluster reduction and final consonant deletion<sup>7</sup>.

The language development depends on the innate biological conditions and of the influence of environment factors, such as family and school<sup>8</sup>.

During the early childhood the family provides the main links, stimulation and care for the development of the children. One of the key elements for stimulation in the family environment is the interaction of the children with the adults and with other children<sup>9</sup>.

When thinking about the family environment as a development aspect, it must be considered that each family has its own characteristics that will enable different opportunities for the children. The family is influenced by its own environment and external factors, it does not act alone, and such influences may affect the development conditions to which the children are exposed<sup>10</sup>.

The school, as a stimulating environment for the development process of the children should provide a continuous learning that allows the knowledge obtained in the first years of life to be deepened in the education institution<sup>11</sup>. As the children attend education institutions increasingly earlier, it is important that the school environment is rich in resources for the stimulation and language development, especially in the pre-school phase in which the children acquire knowledge that contribute to a good academic and social achievement<sup>12</sup>.

Before the importance of the family and school environment in the language acquisition and development, the present study aims to describe and to analyze the phonological development of children with ages between 4 to 5 years and 11 months attending childhood education institutions in the city of Belo Horizonte, to compare the phonological development of children of public and private schools and to verify the relationship between language development and resources of the family and school environments.

## ■ METHODS

This study was approved by the Research Ethics Committee of the Federal University of Minas Gerais, opinion no. ETIC288/10.

This is an observational analytic cross-sectional study with non-probability sample conducted from September 2010 to March 2011, which evaluated the phonological profile and auditory processing and of 96 children aged between 4 and 5 years and

11 months from three childhood education institutions of the northeast regional of the city of Belo Horizonte, Minas Gerais, being two institutions of public funding and a private institution.

For the participation of the students in the research, the following inclusion criteria were considered: signature of the free and cleared term of consent by the parents or guardians of the children aged between 4 and 5 years and 11 months after receiving explanation and clarification about the study.

The exclusion criteria were: less than 70% of the Inventory of Resources of the Family Environment – (RAF)<sup>12</sup> answered by the parents or guardians of the child, no cochleopalpebral reflex in the evaluated child, children that did not participate in all stages of the evaluation due to non-attendance in the institution or no conditions for evaluation, and that present neurogenic or cognitive impairment.

To conduct the research, the parents or guardians of the child received information about the voluntary nature of the study, its purposes and repercussions. After reading and clarifying doubts, the signature of the free and cleared term of consent was requested.

To conduct the study, the following instruments were used: RAF–Inventory of Resources of the Family Environment<sup>13</sup>, phonology test of the ABFW–Child Language Test<sup>7</sup>, Simplified Evaluation of Auditory Processing (ASPA).

For the evaluation of the family environment it was used a questionnaire proposed by the literature with open questions and multiple-choice items<sup>13</sup>. The instrument sorted in ten topics was applied in the form of semi-structured interview, in which each topic was orally exposed to the child's parents or guardian. In each topic, the interviewer started asking the first open question, then marked the items mentioned by the respondents in their free response and following presented each one of the remaining items. If the responses involved items not listed on the instrument, they were included under "other". The raw scores in each of the ten topics was the sum of the marked items, except the topics eight, nine and ten that have a specific score. For a relative score, the formula gross score/maximum score x ten was calculated, where the maximum score is the number of items, except in topics eight, nine, ten, according to the literature<sup>13</sup>.

For the phonological evaluation, a test proposed by the literature<sup>13</sup> was used in which the child named 34 figures and repeated 39 words spoken by the evaluator. In the naming test, the evaluator asked the child to name the presented figures and if the child did not know any of them, the evaluator named the figure and showed it again after a sequence of

5 figures. If after the second attempt the child did not name the figure or named it incorrectly, it was recorded. In the imitation test the children should repeat the words spoken by the evaluator and if they could not do it in an intelligible form, they were requested to repeat the word at the end of the 39 words. The responses were audio recorded for analysis, and phonetically transcribed in the naming and imitation record protocols and in the analysis sheets of the phonological processes of the test. For the analysis of each test, the phonological processes that occurred above 25% of its possibility were considered productive and less than 25% not productive.

The Simplified Evaluation of Auditory Processing (ASPA) consisted in the application of tests for evaluation of the sound localization hearing abilities, simple temporal ordering for verbal sounds and simple temporal ordering for non-verbal sounds, as proposed by the literature<sup>14</sup>. The following tests were performed: sound localization, sound sequencing of verbal and instrumental sounds. The research of cochleopalpebral reflex was also conducted. The sound localization test was performed with the sound of a rattle. The instrument was 20 cm away from the child and the auditory stimulus was in the right, left, above, behind and ahead of the child. For evaluation of the sound sequencing of verbal sounds, the evaluator asked the child to repeat three different sequences formed by four syllables. In the evaluation of the sound sequencing of instrument sounds, four sequences, including sounds of four instruments (bell, agogo, coco and rattle), were presented and the child should tell in which order the instruments were played. During the evaluation of the sound source localization and sound sequencing of instrumental sounds the child was blindfolded. And finally, for the evaluation of the cochleopalpebral reflex in order to exclude conductive problems or moderate, severe and profound hearing loss, the agogo (large size) was used. The sound stimulus was presented in a lateral plane, 20 cm away from the pinna of the child, during two seconds, keeping an interval of 30 seconds between stimuli. The analysis of the Simplified Evaluation of Auditory Processing followed the criteria proposed by the

national literature<sup>14,15</sup>, in the evaluation of sound source localization the child should hit four of the five directions presented, the expected error was in one of the directions: ahead, behind or above the head. In the sequencing of verbal and instrumental sounds it was expected that the child would hit two sequences of three syllables and of three sounds, respectively, in three trials.

The phonology and auditory processing evaluations were conducted in a room of the institution, in one session lasting approximately 20 minutes.

The collected information was entered into a database developed in Excel®. The descriptive results were obtained using frequencies and percentages for the characteristics of various categorical variables and attainment of measures of central tendency (average) and measure of dispersion (standard deviation) for the quantitative variables.

The Pearson Chi-square Test and Fisher's Exact Test (if required) were used to verify the association between the categorical variables. For comparison of the RAF-Resources of the Family Environment according to phonology, auditory processing and education, the Mann-Whitney nonparametric test (only for two comparison groups) or the Kruskal Wallis nonparametric test (for more than two comparison groups) were used. A significance level of 5% was considered. For the comparisons whose p-value was lower than 0.05 there was a statistically significant difference. The analysis was performed using PASW Statistics software version 18.0.

## ■ RESULTS

The sample comprised data from 96 children, 52 males and 44 females, aged between four years and five years and 11 months belonging to two childhood education institutions of public funding (A and B) and one of private funding. The observed characteristics are shown in Table 1.

The results in Figure 1 show that the most frequent phonological processes were: liquid simplification, cluster reduction and final consonant deletion. The latter process showed the highest occurrence in the imitation test.

**Table 1 - Characteristics of the evaluated sample**

Characteristics	N	%
<b>Age</b>		
4 years	42	43,8
5years	54	56,3
<b>Gender</b>		
Female	44	45,8
Male	52	54,2
<b>School</b>		
A	30	31,3
B	27	28,1
C	39	40,6
<b>Parental education</b>		
Primary education	24	25
Secondary education	44	45,8
High education	28	29,2

Legend: N = number of subjects

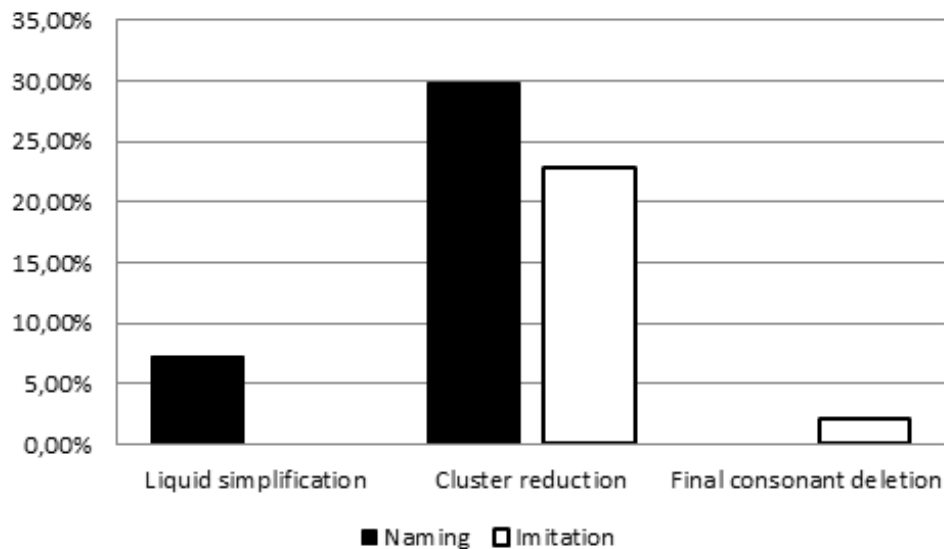
**Figure 1 - Representative Graph of the most common phonological processes in the sample**

Table 2 presents the phonological profile of the evaluated children related to the variables: age, gender, parental education by childhood education institution. It is observed that the participants who achieved the best results were those with approximately 4 years old, female, children with

parents with education up to the secondary school and of private education institution. There was no statistically significant association between appropriate/inappropriate phonological profiles with the evaluated characteristics.

**Table 2 - Relation between the phonological profile and the evaluated characteristics**

Characteristics	Phonological Profile				p
	Appropriate		Inappropriate		
	N	%	n	%	
<b>Age</b>					
4 years	39	92,9	3	7,1	1,000 <sup>1</sup>
5 years	50	92,6	4	7,4	
<b>Gender</b>					
Male	47	90,4	5	9,6	0,447 <sup>1</sup>
Female	42	95,5	2	4,5	
<b>Parental education</b>					
Primary education	23	95,8	1	4,2	0,756 <sup>2</sup>
Secondary education	40	90,9	4	9,1	
High education	26	92,9	2	7,1	
<b>Institution</b>					
A	28	93,3	2	6,7	0,595 <sup>2</sup>
B	26	96,3	1	3,7	
C	35	89,7	4	10,3	

1-Fisher's Exact Test

2-Pearson Chi-square Test

3- Legend: N = number of subjects

The result of the phonological profile related to the stimulation received by the child from the family, presented in Table 3, showed that children with appropriate phonological profile presented better scores in the RAF-Resources of the Family

Environment compared to children with phonological alteration. It is also observed that the participants of the private institution presented higher scores when compared to students from public institutions. No statistically significant results were obtained.

**Table 3 - Relationship between phonological profile and family influence**

Institution	Phonological profile	RAF		Value -p <sup>1</sup>
		N	Average	
A	Inappropriate	2	49,9	0,717
	Appropriate	28	52,4	
B	Inappropriate	1	49,7	-
	Appropriate	26	53,7	
C	Inappropriate	4	69,1	0,941
	Appropriate	35	71,2	
Total	Inappropriate	7	60,9	0,740
	Appropriate	89	60,2	

1-Mann-Whitney Test

2-Legend: N = number of subjects, RAF = Resources of the family environment

In the analysis of the relationship between phonological profile and parental education it is observed that most of the parents of the children attended up to the secondary school (Table 4). The two childhood education public institutions presented higher number of parents only with primary education and

secondary education compared to private institution. In general it is observed that children who have parents with only primary education as those having parents with higher education showed a higher amount of appropriate results.

**Table 4 - Relationship between phonological profile and parental education**

Institution	Phonology	Parental education						value-p <sup>1</sup>
		Primary education		Secondary Education		High Education		
		n	%	n	%	n	%	
A	Inappropriate	0	0,0	1	5,9	1	16,7	0,243
	Appropriate	7	100,0	16	94,1	5	83,3	
B	Inappropriate	1	6,3	0	0,0	0	0,0	0,700
	Appropriate	15	93,8	10	100,0	1	100,0	
C	Inappropriate	0	0,0	3	17,6	1	4,8	0,404
	Appropriate	1	100,0	14	82,4	20	95,2	
Total	Inappropriate	1	4,2	4	9,1	2	7,1	0,756
	Appropriate	23	95,8	40	90,9	26	92,9	

1-Pearson Chi-square Test

The Odds Ratio result regarding the occurrence of phonological alteration related to the auditory processing, presented in the Table 5, shows that children with auditory processing alteration have

0.19 times more chance of presenting phonological alteration when compared to children without alteration.

**Table 5 - Relationship between auditory processing and phonological profile**

Phonology	Auditory processing				value-p <sup>1</sup>	OR	IC 95%
	Inappropriate		Appropriate				
	N	%	N	%			
Inappropriate	1	2,3	6	11,3	0,126	0,19	0,01-1,68
Appropriate	42	97,7	47	88,7		1,00	

1-Pearson Chi-square Test

Legend: N = number of subjects, OR = Odds Ratio, IC 95%= - Confidence Interval of 95%

## ■ DISCUSSION

The sample composed of data from 96 children was heterogeneous, because as it is a non-probabilistic sample the number of participants was not controlled.

The results show that the most frequent phonological processes in children aged from four years to

five years and 11 months, were liquid simplification, cluster reduction and final consonant deletion. These findings corroborate national studies, one that evaluated the speech of 95 children in preschool age<sup>16</sup> and another that evaluated phonological processes of 240 children, aged between three and eight years, with normal phonological development<sup>6</sup>.

With regard to gender, non-statistically significant results were obtained, but it is observed that the male participants presented higher amount of poor results when compared to females. Regarding the age of the participants, most of the sample consisted of children aged 5 years; they presented poorer results when compared to participants aged 4 years. This finding does not corroborate studies that show that the higher the age the better is the phonological suitability<sup>17-19</sup>. This research corroborates a national study that showed that children aged five years presented higher prevalence of phonological deviations when compared to the four years old group<sup>20</sup>. In the present study the sample heterogeneity may have contributed to this result.

Studies show that children who have mothers with secondary or high school education present better communicative and cognitive development<sup>21-23</sup>. Longer education time of the mothers allows them to acquire greater knowledge and have a better perception about language related material aspects. Such factors are of great importance for the development of the language, in the expressive as in the receptive part of a child<sup>24</sup>. This study did not present results that relate better development of the phonological profile of the participants with the longer education time of the parents.

From an early age the family offers the first stimulus for the development of the child<sup>8,25</sup>. The present study showed that the highest scores in the assessment of RAF-Resources of the Family Environment were achieved by children without phonological alteration. A national study<sup>26</sup> analyzed the relationship between family environment and school performance of children between five and six years old in a public school, the results indicated a positive association between performance and resources of the family environment (RAF), especially toys, newspapers, magazines and books and the relation between these data and the education of the mother. Thus, the positive influence of the family stimulation from the early childhood education is highlighted.

Hearing is important for the learning, language and communication structure. It includes receiving, analyzing and interpreting the sounds. By listening the individuals acquire knowledge about the physical world in which they are inserted and use language as a communication tool. A study showed that children exposed to lower levels of family stressors presented better performance in the evaluation of

the auditory processing. It shows the relationship between language, hearing and environment<sup>27</sup>.

In the results of the study there was no statistical significance of the Odds Ratio in the relationship between the presence of phonological alteration and auditory processing. But it was observed that a considerable amount of children with appropriate phonological development showed poor results in auditory processing. These findings do not corroborate national studies<sup>5,28-30</sup> that show evidence of a relationship between auditory processing alteration and the presence of phonological alterations, whereby children with phonological alteration present poorer results in the evaluations of the auditory processing when compared to children with normal phonological development. The finding of the present study may be due to the heterogeneity of the sample and randomness in the selection of the participants.

The discussion about the relation between the phonological development and the resources of the family and school environments can be considered relevant and may also contribute to the progress of the investigation in the area of communicative development and its interface with education. Despite the contributions of the study, some limitations were observed during its realization. Two of them were the size and design of the sample, since only three educational institutions were used as study field. Furthermore, non-probabilistic sample prevents generalizations of the findings.

Although the work does not allow generalizations, exploratory and initial research of the elements of this study contribute to the understanding of the interrelationships between childhood education and phonoaudiology.

## ■ CONCLUSION

The relationship between phonological profile and auditory processing in the age of four years to five years and 11 months showed that children with appropriate phonological profiles presented better results in activities related to the stimulation received from the family and attended a private institution. The level of parental education was not a determinant factor for the presence or absence of phonological alterations as occurred with the presence of adequacy/inadequacy of the auditory processing.

**RESUMO**

**Objetivo:** descrever e analisar o perfil fonológico de crianças na faixa etária de 4 anos a 5 anos e 11 meses frequentadoras de instituições de ensino infantil do município de Belo Horizonte, comparar o desenvolvimento fonológico das crianças do ensino público e privado e verificar a relação entre o desenvolvimento de linguagem e os recursos dos ambientes familiar e da escola. **Métodos:** o estudo avaliou o desenvolvimento fonológico e o processamento auditivo de 96 crianças na faixa etária entre 4 e 5 anos e 11 meses pertencentes a três instituições de ensino infantil e também foi avaliado o ambiente escolar. **Resultados:** os processos mais frequentes foram simplificação de líquida, simplificação de encontro consonantal e simplificação de consoante final. Na avaliação do processamento auditivo a maioria das crianças obteve resultado adequado. Foi observado que crianças que recebem menor estimulação familiar e frequentadoras de instituições públicas demonstraram chances maiores de apresentarem alteração fonológica. **Conclusão:** os resultados do estudo mostram a importância de uma boa estimulação do ambiente no qual a criança está inserida. Deste modo é de grande relevância que mais estudos sejam realizados e que verifiquem a influência do ambiente familiar e da escola na aquisição da linguagem infantil.

**DESCRIPTORIOS:** Ambiente; Família; Linguagem; Fonoaudiologia; Desenvolvimento Infantil

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