

Phonological acquisition of Brazilian Portuguese: a systematic review about the consonantal development

Aquisição fonológica do Português Brasileiro: revisão sistemática sobre o desenvolvimento das consoantes

Adquisición fonológica del Portugués Brasileño: revisión sistemática sobre el desarrollo de consonantes

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Abstract

Introduction: Knowledge about phonological acquisition is a guideline for clinical practice in the assessment of phonological disorders. **Objective:** To perform a systematic review of scientific publications on consonant phonological acquisition of Brazilian Portuguese (BP) by children with typical linguistic development. **Methods:** there were selected descriptors that meet the question “*what is the age of typical consonant phonological acquisition in monolingual Brazilian Portuguese (BP) speakers?*” in the databases Bireme, Pubmed, Scopus, Web of Science, Portal Periódicos Capes and Google Scholar, and gray literature. The inclusion criteria were that it was a consonant phonological acquisition of BP by children. Studies on the acquisition of: vowels and/or diphthongs, linguistic domains other than phonology, second language or bilingual, language other than BP, reading, writing, spelling, sign language, as well as research with phonetic analysis, speech data of children with speech disorders, about written text, and unnatural language were excluded. The types of study, objectives and acquisition indicators were considered. The selected studies were analyzed by the STROBE Initiative and the GRADE

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LPR: Construction of the research question, search of data, analysis and selection of articles, articles writing, general revision and working coordination.

AF: Construction of the research question, search of data, analysis and selection of articles, articles writing, text revision.

ACSB: Construction of the research question, search of data, analysis and selection of articles, articles writing, GRADE analysis.

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System. **Results:** Of the 1,381 studies obtained, 33 were selected. Consonant phonological acquisition was identified between one year and four months to seven years, depending on the phoneme or class of phonemes and showing great variation between individuals. The definition of acquisition converged to the frequency of 75% to 85% of correct productions of the consonant or syllabic structure. **Conclusion:** It was found that the consonant phonological acquisition presents a wide variation in individuals and between different consonants and of these in the different syllabic structures.

Keywords: Language Development; Child; Speech; Speech, Language and Hearing Sciences; Brazil.

Resumo

Introdução: O conhecimento sobre aquisição fonológica é balizador para a prática clínica na avaliação de transtornos fonológicos. **Objetivo:** Realizar revisão sistemática das publicações científicas sobre aquisição fonológica consonantal do Português Brasileiro (PB) por crianças com desenvolvimento linguístico típico. **Metodologia:** Foram selecionados descritores que atendiam à pergunta de pesquisa “*qual a idade de aquisição fonológica consonantal típica de crianças falantes monolíngues do Português Brasileiro (PB)?*” nas bases de dados Bireme, Pubmed, Scopus, Web of Science, Portal Periódicos Capes e Google Acadêmico, e literatura cinzenta. Critério de inclusão foi tratar-se de aquisição fonológica consonantal do PB por crianças. Excluíram-se estudos sobre aquisição de: vogais e/ou ditongos, domínios linguísticos que não fossem fonologia, segunda língua ou bilíngue, outra língua que não o PB, leitura, escrita, soletração, língua de sinais, também pesquisas somente com análise fonética, com dados de fala de crianças com alterações de fala, texto escrito, e linguagem não natural. Foram considerados os tipos de estudo, objetivos e indicadores de aquisição. Os estudos selecionados foram analisados via Iniciativa STROBE e Sistema GRADE. **Resultados:** Dos 1.381 estudos obtidos, selecionou-se 33. A aquisição fonológica consonantal foi identificada entre as idades um ano e quatro meses a sete anos, dependendo do fonema ou classe dos fonemas, apresentando grande variação entre indivíduos. A definição sobre aquisição convergiu para a frequência de 75% a 85% de produções corretas da consoante ou estrutura silábica. **Conclusão:** Constatou-se que a aquisição fonológica consonantal apresenta ampla variação entre indivíduos e entre diferentes consoantes e destas nas diversas estruturas silábicas.

Palavras-chave: Desenvolvimento da Linguagem; Criança; Fala; Fonoaudiologia; Brasil.

Resumen

Introducción: El conocimiento sobre la adquisición fonológica es una guía para la práctica clínica en la evaluación de los trastornos fonológicos. **Objetivo:** Realizar una revisión sistemática de publicaciones científicas sobre la adquisición fonológica consonante del portugués brasileño (PB) por parte de niños con desarrollo lingüístico típico. **Metodos:** Se seleccionaron descriptores que cumplieron con la pregunta “*¿Cuál es la edad de adquisición fonológica consonante típica en hablantes monolingües de portugués brasileño (BP)?*” en las bases de datos Bireme, Pubmed, Scopus, Web of Science, Portal Periódicos Capes y Google Acadêmico, y literatura gris. Los criterios de inclusión fueron la adquisición fonológica consonante de PA por parte de los niños. Se excluyeron los estudios sobre la adquisición de: vocales y/o diptongos, dominios lingüísticos distintos de la fonología, segunda lengua o bilingüe, distintos de BP, lectura, escritura, ortografía, lengua de signos, también investigaciones con análisis fonético. Con datos de habla de niños con trastornos del habla, texto escrito y lenguaje antinatural. Se consideraron los tipos de estudio, objetivos e indicadores de adquisición. Los estudios seleccionados fueron analizados por la Iniciativa STROBE y el Sistema GRADE. **Resultados:** De los 1381 estudios obtenidos, se seleccionaron 33. Se identificó adquisición fonológica consonante entre las edades de un año y cuatro meses a siete años, dependiendo del fonema o clase de fonemas y mostrando gran variación entre individuos. La definición de adquisición convergió a la frecuencia del 75% al 85% de producciones correctas de la estructura consonante o silábica. **Conclusión:** Se encontró que la adquisición fonológica consonante presenta una amplia variación entre individuos y entre diferentes consonantes y de estas en las diferentes estructuras silábicas.

Palabras clave: Desarrollo del Lenguaje; Niño; Habla; Fonoaudiología; Brasil.

Introduction

Language is a major aspect of human development for social relationships, it is through it that the child exercises social interaction, starts making requests, executing orders, gaining greater independence to relate to others and experiencing the world¹. Language is observed from its different linguistic domains, that are responsible for distinct aspects concerning: social use; syntactic composition; semantic value; morphological structure; and the minimum unit - the phoneme².

The phonemes of a language are not acquired uniquely, for example, age of the child; consonantal classes; and syllabic configuration³⁻⁴. For this reason, the period of phonological expansion is long, ranging from one year and six months to four years old⁵⁻⁶. About consonant classes, studies present that development is established first with plosive and nasal consonants, followed by fricatives and, finally, by liquids⁵. As the phonological system consists of phonemes organized into different types of syllables, each syllable configuration presents various difficulties and, consequently, a particular acquisition period⁷. The consonant/vowel syllable (CV), for example, is present from the beginning of the speech as it is one of the less complex³.

Although several studies are describing the phonological acquisition of children, compiling data from different surveys on the phonological acquisition of Brazilian Portuguese (BP), speech therapists, pediatricians, and teachers need to have knowledge on typical development indicators so they can be aware of deviations or delays for each age group. Thus, this study aims to understand the results of studies that investigated the phonological acquisition of BP consonants, explaining these findings to support professional practice.

Methods

This study aims to systematically analyze the scientific literature related to the phonological acquisition of Brazilian Portuguese by children with typical language development.

The question of this research, configured as a systematic literature review, was “what is the age of typical consonantal phonologic acquisition of monolingual Brazilian Portuguese (BP) speakers?”.

The PECOT guideline outlined the study in the following terms: children as the population to be researched; the consonantal phonological acquisition of BP as an exposure factor; typical development as a controlling factor; the acquisition age as an outcome factor; and as an observational study.

The databases searched were: Bireme, Pubmed, Scopus, Web of Science, Portal Periódicos Capes, and Google Scholar, in addition to gray literature. The descriptors were selected according to the structured vocabulary of Descriptors in Health Sciences (DeCS), being used: “Child” AND “Brazilian Portuguese” AND “child language” OR “language development” AND “verbal behavior” OR “speech intelligibility” OR “language” OR “speech”, which were adapted according to the needs of each database. The Boolean operators “AND” and “OR” were used according to the objective, the first being to combine with the following terms and the second to alternate between one of the terms used. The Boolean operator “NOT” was not used. The search and analysis of the articles were made by four researchers, who analyzed the data found independently at all stages, using the selection criteria outlined for the study.

The inclusion criteria adopted were: being a consonant phonological acquisition, being the oral acquisition of mother tongue by children, and referring to the BP acquisition of BP. The exclusion criteria used were: acquisition of vowels and/or diphthongs; acquisition of linguistic domains other than phonology; acquisition of bilingual or second language; acquisition of a language other than Brazilian Portuguese; reading; writing, spelling; phonetic analysis; sign language; speech data from children with phonological and/or phonetic alterations; written text analysis; and unnatural language.

For the analysis of the selected studies, the following items were considered: the composition of the sample, the research design, the definition of acquisition, the studied object, and the main results. Then, the analysis was performed by the STROBE Initiative (Strengthening the Reporting of Observational Studies in Epidemiology)³⁴, which is a list of 22 items recommended for complete writing in observational studies. This strategy divides items in the title, abstract, introduction, methodology, results, and discussion that, if appropriate, enable a complete critical reading of the study. Despite being a checklist, the initiative does not classify

the quality of the studies analyzed, only whether the recommended items are present or not. The GRADE System (Grading of Recommendations, Assessment, Development and Evaluation)³⁵ is a system that allows determining the quality and strength of recommendation for generalizing study results and was also used for analysis. The System adapts to the research question but maintains its focus on comparing interventions. Studies can be determined as HIGH if any future research is very unlikely to change the confidence in the effect estimated; MODERATE, in which it is likely that further research will have an important impact on the confidence of the effect estimated, and may change it; LOW, future researches are likely to have a major impact on the confidence in the effect estimated and is likely to change it; and VERY LOW, that any effect estimated is very uncertain.

Results

The search for scientific materials happened between October and November 2019, and the publication period of the studies was not defined. All titles found in the search were tabulated, totaling 1,381 works. Of these, 307 appeared more than once, adding up to 799 repeated studies. After this investigation, the selection stage of scientific papers began, which was divided into three phases. In the first phase, all studies found had the titles read, after those whose titles expressed they were not related to the subject of this systematic review were excluded. In the second phase, the abstracts of the studies were read, and in the third phase they were read in full, and those who presented content that met all the inclusion criteria remained in this work, totaling 33 studies. The entire flow and quantity of these steps are illustrated in Figure 1.

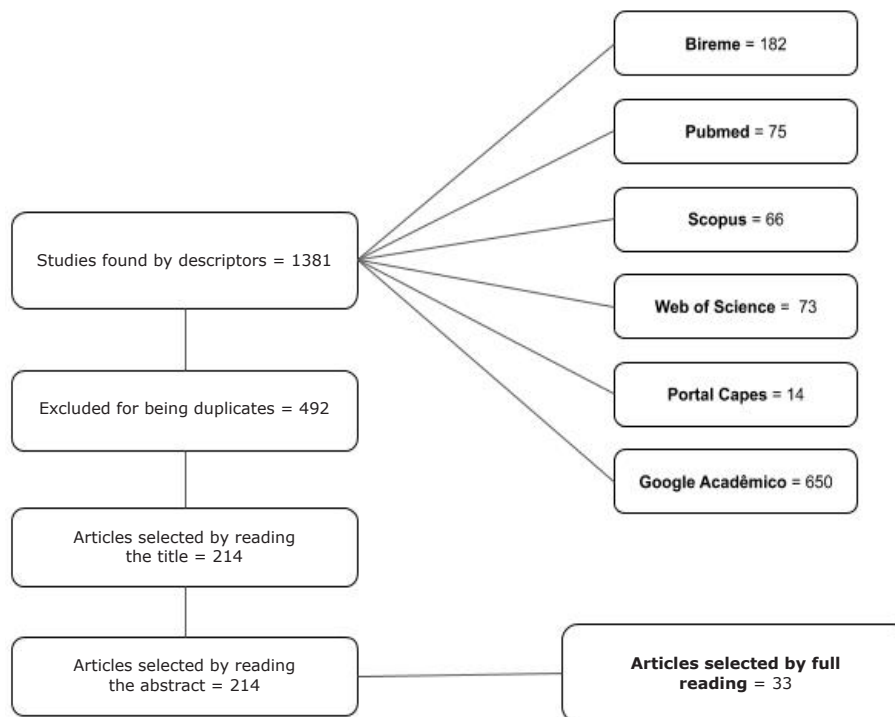


Figure 1. Methodological flow

The essential characteristic of the studies is the fact that they are observational. In addition, the formats of the selected works are articles published in indexed journals, master's dissertations, doctoral theses, and book chapters. Several studies

were carried out in the south of Brazil, followed by the northeast and southeast regions. The items analyzed and the main results of the selected studies are in Chart 1.

Chart 1. Main results of selected studies.

Study	Sample	Design	Definition of Acquisition	Object of Study	Main Results
Klunk [1] 2018	n=1 child, followed at the ages of 1:1 to 2:2, from a Brazilian Southern city.	Longitudinal	Absent	Words and phonological processes	Plosives and nasal acquired until 1:11
Wiethan et al. [2] 2016	n=186 children, ages between 1:6 e 5:11, from a Brazilian Southern city.	Cross-sectional	Correct production rate with a minimum frequency of 80%	All consonants	The phonemes of state 0, level 1, and 2 are: /p, t, m, n, ʃ, b, d/ e are acquired by all children around 2:8 and 2:11. The phonemes of levels 3, 4, and 5 (/ k, g, f, v, s, z /) stabilized in the range of 4:0 to 4:3. The phonemes of levels 6, 7, 8,9 (/l, ʃ, ʒ, r, R, Λ/) are acquired by most children between 4:0 and 4:3.
Matzenauer and Miranda [3] 2012	n=1 child, followed at the ages of 1:9 to 2:7, from a Brazilian Southern city	Longitudinal	Absent	All consonants, syllables and distinctive features	Plosive, nasal, and /f/ already acquired with 1:9. Acquisition of /v/ with 2:0 and /s,z/ acquired with 2:7.
Mezzomo et al. [4] 2010	n=170 children, ages between 1:2 and 3:8, from two Brazilian Southern cities (study 1) n=1 child, followed at the ages of 1:1 to 3:4, from a Brazilian Southern city. (study 2)	Cross-sectional (study 1) Longitudinal (study 2)	Correct production rate with a minimum frequency of 80% in three consecutive age groups	Consonants in the medial and final coda	Cross-sectional data show acquisition of final lateral coda occurs at 1:4 and medial-lateral coda occurs at 3:0; final and medial nasal coda occurs at 2:2; final fricative coda occurs at 2:6 and the medial fricative coda occurs at 3:0, and final and medial non-lateral coda occurs at 3:8. Longitudinal data show acquisition of final lateral coda occurs at 1:6 and medial-lateral coda occurs at 2:1; final nasal coda at 1:7 and medial at 1:4; final and medial fricative coda occurs at 3:2; final non-lateral coda at 3:0 and medial occurs at 3:2.
Rodrigues et al. [5] 2015	n=86 children, ages between 3:0 and 6:11, from a Brazilian Southern city.	Cross-sectional	Correct production rate with a minimum frequency of 75%	The coronal non-lateral liquid in complex onset and coda	Phoneme /r/ in simple onset is acquired at 4:0 and in complex onset at 6:0.
Queiroga et al. [6] 2010	n=100 children, ages between 2:0 and 6:11, from a Brazilian Northeastern city.	Cross-sectional	Correct production rate with a minimum frequency of 80%	Consonants in the complex onset	The acquisition age varied according to the observed group: /pr/ e /kl/ with 3:6 - 3:11, /br/ e /fl/ with 3:0 - 3:5, /tr/, /kr/, /pl/, /gr/, /fr/, /vr/, /gl/, /dr/ with 4:0 - 4:5 and /bl/ did not reach the acquisition indicator.
Castro [7] 2015	n=40 children, ages between 2:6 and 5:11, from a Brazilian Northeastern city.	Cross-sectional	Significant relative weight rate by statistical analysis	Consonants in the complex onset	Age of acquisition between 5:0 - 5:5.
Avila [10] 2000	n= 100 children, ages between 2:0 and 3:7, from a Brazilian Southern city	Cross-sectional	Correct production rate with relative weight $\geq .60$	Consonants in complex onset and dorsal stops in the sequence [k ^w , g ^w]	Fricatives and stops with /l/ acquired with 3:6 - 3:7. Dorsal stops in the sequence [k ^w , g ^w] acquired in the age groups studied, since 2:0, and behave as a complex segment and not as a complex sequence of consonants.

Study	Sample	Design	Definition of Acquisition	Object of Study	Main Results
Silva [11] 2008	n=1 children, followed at the ages of 1:1 to 2:2, from a Brazilian Southern city. (study 1) n=46 children, ages between 2:0 and 4:1, from a Brazilian Southern city. (study 2)	Longitudinal (study 1) Cross-sectional (study 2)	Correct production rate with a minimum frequency of 80% in three consecutive age groups	Phonemes /s/ and /z/ in onset; medial and final fricative coda	Longitudinal data show the phoneme /s/ in initial onset acquired at 2:4 and medial at 2:5. Phoneme /z/ in medial onset acquired at 2:2. Acquisition of the medial fricative coda at 3:0 and the final fricative coda at 3:9. Cross-sectional data show acquisition of the medial fricative coda at 4:0 and the final fricative coda at 3:10.
Staudt [12] 2008	n=8 children, followed at the ages 2:0 to 5:0, from a Brazilian Southern city.	Longitudinal	Correct production rate with a minimum frequency of 85% in three consecutive age groups	Consonants in the complex onset	Acquisition age varies from individual to individual, in which the earliest acquisition occurred at 3:8 and the latest at 5:0. There is a reference for acquisition with the following ages: 3:8, 3:10, 4:0, 4:5, 5:0. The description of the acquisition of the groups of obstruent + /l/ or /r/ was made separately, but the acquisition ages for the same child are the same in both groups (the only difference reported was one month between one group and another with the same child).
Montenegro [13] 2012	n=38 children, ages between 2:0 and 6:11, from a Brazilian Southern city.	Cross-sectional	Correct production rate with a minimum frequency of 85%	Consonants in the complex onset	Age of acquisition 5:0 to 5:5.
Wiethan [14] 2015	n=186 children, ages between 1:6 and 5:11, from a Brazilian Southern city.	Cross-sectional	Correct production rate with a minimum frequency of 80%	All consonants	Phonemes appeared with acquisition indicators at the following ages: /b, k, t/ between 1:6 and 1:11; /m, p, n, v/ between 2:0 and 2:3; /d, n/ between 2:4 and 2:7; /l, j, f, g/ between 2:8 and 2:11; /ʒ/ between 3:0 and 3:3; /s, z, R/ between 3:4 and 3:7; /k/ and fricative coda between 3:8 and 3:11; non-lateral coda between 4:0 and 4:3; /r/ between 4:8 and 4:11; complex onset with /r/ between 5:0 and 5:3. The complex onset with /l/ did not reach acquisition indicators until 5:11 (it was between 40% and 79%).
Cordeiro et al. [15] 2013	n=40 children, ages between 2:0 and 6:11, from a Brazilian Northeastern city.	Cross-sectional	Correct production rate with a minimum frequency of 80%	Coronal fricatives in the simple onset	The acquisition age of all coronal fricatives in the initial onset position is 3:0 - 3:5. The age of acquisition of the coronal fricatives /z, ʒ, ʒ/ in medial onset is also 3:0 - 3:5, while the fricative /s/ occurs at 2:6 - 2:11. Such acquisition ages are observed in any tonicity position. The acquisition age of all coronal fricatives in the initial onset position is 3:0 - 3:5. The age of acquisition of the coronal fricatives /z, ʒ, ʒ/ in medial onset is also 3:0 - 3:5, while the fricative /s/ occurs at 2:6-2:11. Such acquisition ages are observed in any tonicity position.
Miranda [16] 2007	n=3 children, followed at the ages 3:1 and 4:5, from a Brazilian Southeastern city. (study 1) n=50 children, ages between 3:0 and 5:11, from a Brazilian Southeastern city. (study 2)	Longitudinal (study 1) Cross-sectional (study 2)	Correct production rate with a minimum frequency of 85%	Consonants in the complex onset	The age of acquisition in the cross-sectional study varied between 3:0 and 5:2. In the longitudinal study, only 1 child acquired the syllable CCV with 3:7.

Study	Sample	Design	Definition of Acquisition	Object of Study	Main Results
Ferrante et al. [17] 2008	n=240 children, ages between 3:0 and 8:0, from a Brazilian Southeastern city.	Cross-sectional	Correct production rate with a minimum frequency of 75%	All consonants	The phonemes /p, b, t, k, g, m, n/ is already acquired in the first age group studied, at 3:0. Fricatives and /ʃ/ are also acquired, but with great variability among children. Liquids /l/ and /r/ in simple onset are acquired at 3:0, o /r/ at 4:0 in simple onset and coda, the complex onset with /l/ at 4:0 and with /r/ at 5:0.
Toreti and Ribas [18] 2010	n=1 child, followed at the ages 1:6 a 2:6, from a Brazilian Southern city.	Longitudinal	Correct production rate with a minimum frequency of 85%	All consonants	The phoneme /p/ is acquired in initial and medial onset with 1:6; /b/ acquired in initial onset with 2:0 and medial with 1:6; /t/ in initial onset with 2:1 and medial with 1:7; /d/ in initial onset with 2:5 and medial with 1:7; /k/ in initial onset with 1:7 and medial with 1:6; /g/ in initial onset with 1:10 and medial with 1:7; /m/ and /n/ in initial and medial onset with 1:7; /f/ in initial onset with 2:5; /s/ in initial onset with 1:11 and medial with 1:10; /ʃ/ in initial onset with 1:7 and medial with 1:6; medial nasal coda with 1:6; and final lateral coda with 1:9.
Dias et al. [19] 2014	n=213 children, ages between 1:1 and 4:11, from a Brazilian Southern city.	Cross-sectional	Correct production rate with relative weight $\geq .60$	Dorsal stops and the sequence [k ^w , g ^w]	The acquisition of /k/ and /g/ showed a higher probability of correct production in the 3:9 and 3:10 age groups. Sequences [k ^w , g ^w] have a higher probability of correct production between 2:3 and 2:6.
Vargas e Mezzomo [20] 2014	n=60 children, ages between 1:6 and 5:11, from a Brazilian Southern city; n=52 children, ages between 3:2 and 5:4, from a Brazilian Southern city.	Cross-sectional	Correct production rate with a minimum frequency of 85% in three consecutive age groups	The non-lateral liquid in the coda	The non-lateral liquid in medial coda occurs with 4:6 and 4:8 in the data of children in one city and the range of 4:10 to 5:0 in the data of children in the other city. The non-lateral liquid in the final coda occurs with 4:6 and 4:8 in the data of children in one city and the range of 4:8 to 4:10 in the data of children in another city.
Toni [21] 2017	n=49 children, ages between 2:4 and 5:10, from a Brazilian Southeastern city.	Cross-sectional	Correct production rate with a minimum frequency of 75%	Consonants in the complex onset	The acquisition of the complex onset is observed in the group of children aged between 5: 2 and 5: 9.
Lopes et al. [22] 2015	n=72 children, ages between 1:0 and 4:0, from two Brazilian Southern cities.	Cross-sectional	Correct production rate with a minimum frequency of 90% and correct production rate with relative weight $\geq .60$	Obstruent consonants	The correct productions reach more than 90% with stability from 2:6 in both groups studied.
Ceron et al. [23] 2017	n=733 children, ages between 3:0 and 8:11, from a Brazilian Southern city.	Cross-sectional	Correct production rate with a minimum frequency of 80% by 75% of children to consider phonological acquisition.	All consonants	Considered ACQUISITION: all stops, nasal, /f, v, s, z, l/ nasal and lateral coda between 3: 0 and 3:5; fricatives /ʃ, ʒ/ and dorsal liquid between 3:6 and 3:11; liquid /ʎ/ with 4:0 and 4:5; liquid /r/ and non-lateral coda at 4:6 and 4:11; complex onset with /r/ ao 5:0 to 5:5; complex onset consisting of stop and /l/ at 5:6 to 5:11; and complex onset composed of fricative and /l/ with 6:0 and 6:5. Considered DOMAIN: all plosives, nasal, /f, v, s, z, l/, nasal and lateral coda between 3:0 and 3:5; dorsal fluid between 3:6 and 3:11; fricatives /ʃ, ʒ/ and liquid /ʎ/ 4:0 and 4:5; liquid /r/ and non-lateral coda at 4:6 and 4:11; complex onset with /r/ ao 5:6 to 5:11; complex onset consisting of stop and /l/ at 6:0 to 6:5; and complex onset composed of fricative and /l/ at 7:0 and 7:5.

Study	Sample	Design	Definition of Acquisition	Object of Study	Main Results
Mezzomo et al. [24] 2014	n=24 children, with typical development, ages between 1:0 and 3:11, from a Brazilian Southern city n=12 children, with typical development, from a Brazilian Southern city (data will not be analyzed)	Cross-sectional	Correct production rate with relative weight $\geq .60$	Consonants in coda	The 3:0 and 3:6 age groups favored the correct production of children with typical phonological development.
Correia [25] 2012	n=28 children, ages between 2:0 and 5:6 from a Brazilian Northeastern city.	Cross-sectional	Correct production rate with a minimum frequency of 80% in two consecutive age groups	Consonants in the complex onset	The 4:0 and 4:6 age groups demonstrate correct productions of the medial complex onset. The 5:0 and 5:6 age groups demonstrate acquisition of the initial complex onset.
Marques and Lazarotto-Volcão [26] 2018	n=2 children, twins, followed at the ages 1:4 to 4:0, from a Brazilian Southern city.	Longitudinal	Correct production rate with a minimum frequency of 86%	Alveolar lateral liquid	The age range of correct production of /l/ in initial onset with more than 85% was observed from 2:10 and in medial onset from 2:8 in one of the children and 2:10 in the other child.
Bueno [27] 2013	n=7 children, ages between 3:0 and 7:0 from a Brazilian Federal District city.	Cross-sectional and Longitudinal	Correct production rate with a minimum frequency of 80%	Non-lateral /R/	/r/ is acquired in complex onset from 4:7; /R/ since the first age group, 3:1; /r/ in simple onset from 4:7; and the coda at 3:1.
Guimarães [28] 2008	n=4 children, followed during 12 months, ages from 1:6 to 1:11, from a Brazilian Southeastern city.	Longitudinal	Absent	Plosives and emergence of affricates	The obstruents are acquired in all subjects. The emergence of affricates varies between individuals.
Silva et al. [29] 2012	n=480 children, ages between 3:0 and 8:0, from a Brazilian Southeastern city, from high and low socioeconomic classes.	Cross-sectional	Correct production rate with a minimum frequency of 75%	All consonants	Children from the lower socioeconomic class: more than 90% acquired between 3:0 and 3:11 the plosives, the nasal ones, the fricatives, liquids /l, R/ and fricative coda. The liquid /l/ was acquired by more than 90% of children in the age range from 5:0 to 5:11 and the /r/ in complex onset between 6:0 and 6:11. The non-lateral coda and the /l/ in complex onset did not reach this percentage of children, even in the last age group (7:0 to 7:11). High socioeconomic class children more than 90% acquired between 3:0 and 3:11 the plosives, the nasal /m, n/, the fricatives, liquids /l, R/ and fricative coda. The liquid /l/ was acquired by more than 90% of children in the 4:0 to 4:11 age group. The dorsal nasal, the non-lateral coda, and the /l/ in complex onset between 5:0 and 5:11. The /r/ in complex onset between 6:0 and 6:11.
Luiz et al. [30] 2013	n=136 children, ages between 1:6 e 4:2, from two Brazilian Southern cities.	Cross-sectional	Correct production rate with a minimum frequency of 85% in three consecutive age groups	Liquid /R/	In one city, children acquired the /R/ in initial onset at 3:4 and in another city at 4:2; the medial onset, it occurs at 3:6 in one city and 4:2 in another.

Study	Sample	Design	Definition of Acquisition	Object of Study	Main Results
Freitas [31] 2004	n=26 children, ages between 1:8 and 2:3 (Ilha, 1993) n=28 children, ages between 2:0 and 2:11 (Azevedo, 1994) n=34 children, ages between 1:6 and 3:3 (Fronza, 1998) n=3 children, followed at ages 1:6 to 3:0 (Rangel, 1988) All the children are from a Brazilian Southern city.	Cross-sectional Cross-sectional Cross-sectional Longitudinal	Correct production rate with a minimum frequency between 80 and 86%	Plosives and nasal consonants. All the children are from a Brazilian Southern city.	The plosives are acquired between 1:6 and 1:8, with the following order: /p, t, k /> / b, d /> /g/. Nasals are acquired between 1:6 and 1:8, with the following order: /m, n /> /ɲ/.
Oliveira [32] 2004	n=91 children, ages between 1:0 and 3:3 (Savio, 2001) n=103 children, ages between 1:0 and 3:8 (Oliveira, 2002)	Cross-sectional	Correct production rate with a minimum frequency between 80 and 86%	Fricative consonants. All children from Brazilian Southern cities	Fricatives are acquired between 1: 8 and 2:10, with the following order: /v/ (1:8), /f/ (1:9), /z/ (2:0), /s, ʒ/ (2:6), /ʃ/ (2:10).
Mezzomo e Ribas [33] 2004	n=12 children, followed at ages 2:9 to 5:5 (Lamprecht, 1993) n=110 children, ages between 2:0 and 3:9 (Miranda, 1996) n=310 children, ages between 2:0 and 7:1 (Hernandorena and Lamprecht, 1997) n=120 children, ages between 2:0 and 4:0 (Azambuja, 1998) n=60 children, ages between 2:0 and 5:0 (Rigatti, 2000) n=3 children, followed at ages 1:6 to 3:0 (Rangel, 1988)	Longitudinal Cross-sectional Cross-sectional Cross-sectional Cross-sectional Longitudinal	Correct production rate with a minimum frequency of between 80 to 86%	Liquid consonants. All children from Brazilian Southern cities	The liquids are acquired between 2:8 and 4:2, in the following order: /l/ (2:8/3:0), /R/ (3:4), /ʎ/ (4:0), /r/ (4:2).
Mezzomo [34] 2004	n=68 children, ages between 1:4 and 3:10 (Mezzomo, 1999) n=170 children, ages between 1:2 and 3:8 (Mezzomo, 2004)	Cross-sectional	Correct production rate with a minimum frequency between 80 and 86%	Consonants in coda	The coda consonants are acquired from 1:7 to 3:10, with the following sequence: Final nasal coda (1:7), medial nasal coda (2:2), lateral end coda (1:4), the medial lateral coda (3:0), final fricative coda (2:6), medial fricative coda (3:0) and medial and final non-lateral coda (3:10).
Ribas [35] 2004	n=134 children, ages between 1:0 to 5:3 (Ribas, 2002)	Cross-sectional	Correct production rate with a minimum frequency between 80 and 86%	Consonants in the complex onset	Consonants in complex onset are acquired at 5: 0.

The number of subjects varies widely in the samples, ranging from one to 733 children. There are five works^{1,3-4,9,16} in which the sample is of only one child and five studies^{15,17,21,27,31} with it larger than 200. The design of all studies with a small corpus, between one to 12 children, is longitudinal. The works with samples from 24 subjects opted for a cross-sectional design.

The research objects of study range from consonants and specific syllabic structures to the analysis of the entire phonological system. Ten studies clarify the stability of consonant phonemes in the syllabic structure of the complex onset^{5-8,10-11,14,19,23,33} and seven on the acquisition of all consonants^{2-3,12,15-16,21,27}. The other works investigate the coda, liquid, fricative, plosive, and nasal phonemes.

The indicators used to define when is the acquisition moment varies a little, using minimum frequencies between 75% to 90% of correct production of the analyzed consonant, with some establishing the verification of these frequencies by two or three age groups in sequence^{4,9-10,18,23,28}, yet most of them already understand the consonant

domain in only one age group. There is one of the studies that even uses the minimum frequencies of correct production by at least 75% of the subjects to consider the acquisition²¹. In addition to this criterion, five studies use statistical analysis to define the domain of the phoneme^{7-8,17,20,22}. Most of these works analyze the variables with the VARBRUL program, whose relative weight equal to or greater than .60 favors the correct production and demonstrates the stability of the consonant.

Discussion

Regarding the age of acquisition, the results shown in all studies demonstrate a wide variation between them, as seen in Figure 2. Likewise, such a range is noticed within each study, which agrees with the findings of numerous works on language acquisition on inter-subject and intra-subject differences. The acquisition ages of consonants in the more complex syllabic structures, coda, and complex onset, as well as those of each class of phonemes in the simple onset position, are also shown in Figure 2.

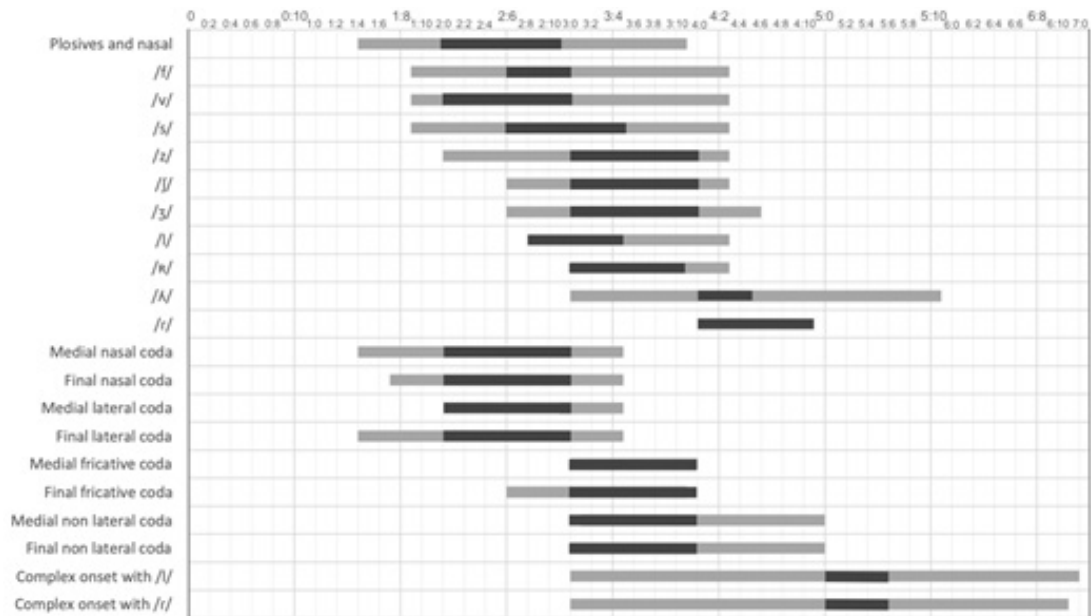


Figure 2. Panorama of phoneme acquisition age, with the most frequent range.

Ages vary widely between one year and four months to five years. Regarding the consonants in the complex onset syllabic structure, studies show very different ages of stability of the liquids in the second consonant position. Some studies mention the variation concerning the consonant group, both regarding the obstruent and the liquid. Widely speaking, initial acquisition ages are three years for some subjects¹⁴ to six to seven years and five months for others^{5,21,27}. One of the studies²⁷ mentions that children did not acquire the complex onset formed with /l/ or in the last age group surveyed, with seven to seven years and eleven months.

The results to the acquisition ages of the plosives and nasal classes also vary a lot. The age of one and a half years appears as the earliest in the acquisition of plosives and nasals^{12,16,29}, extending up to three years and eleven months in some studies^{2,17,21}. The acquisition of the fricatives is heterogeneous when related to the age of domain on each of the phonemes that make up the category,

as well as, in terms of the position in the word, starting the stability of labial fricatives close to one year and nine months. Of all the studies, the latest age for acquiring fricatives in one of the studies² is between four and four years and five months. Liquids are phonemes that, like fricatives, are quite heterogeneous in the acquisition ages, ranging from two years and eight months to five years and eleven months, depending on the consonant and the research variables.

Table 1 shows the analysis of the STROBE initiative of the articles included in this review, showing that, in most studies, the methodological aspects are shown partly. These results in failures and compromises the understanding and replication of studies. For example, none of the studies presented how the sample size was determined. Aspects related to the discussion also, for the most part, do not appear in their entirety. It is possible to infer that methodological flaws cause consequences when studies are interpreted and generalized.

Table 1. Analysis of article distribution of methodology and discussion items according to the STROBE Initiative.

Methodological Variables	Total (n%)	Partial (n%)
Study design	17 (51%)	16 (49%)
Context	6 (18%)	27 (82%)
Participants	15 (45%)	18 (55%)
Variables	16 (49%)	17 (50%)
Data source / measurement	8 (24%)	25 (76%)
Bias	6 (18%)	27 (82%)
Study size	3 (9%)	30 (91%)
Quantitative Variables	16 (49%)	17 (51%)
Statistical methods	14 (43%)	19(57%)
Restrictions	11 (33%)	22 (64%)
Interpretation	8 (24%)	25 (76%)
Generalization	15 (45%)	18 (55%)

Subtitle: n=number of studies; %=percent.

The analysis by the GRADE System was adjusted according to the objectives: observational methodology studies were considered the gold standard for the research question and were not punished with grade reduction, as expected³⁵; the other original criteria were followed. Even with such adaptation, no study reached the “High” quality standard, as all of them had some methodological flaw that allows the presented results to change the effect estimate. Of all the studies, seven

works^{1,3,6,11,15,19} showed a “Low” quality standard for not showing sufficient generalization applicability and lack of relevant data for consolidating the results. The remaining 26 studies were classified as having a “Moderate” quality standard for failing in some aspects, such as critical limitation to the quality of the studies; major inconsistency; uncertainties about the results; and inaccurate or vague information or high probability of bias. No study used expressive methods to reduce possible

biases, thus, it was not possible to increase the grade in any case.

Conclusion

To sum up, the search for analysis on language acquisition provides a lot of studies on language development. There is also a wide variety of researched phenomena, covering different language domains, different languages, forms of expression, and other variables. This variety demonstrates the possibility of numerous future revisions for the investigation of other linguistic phenomena.

The filter used in this work showed diversity in the findings of the ages of phonological acquisition in BP, yet a convergence in the age groups was found, demonstrating an acquisition pattern within a set range. The definition of acquisition of each consonant is delimited on the frequency of correct production of sounds, whose indicator is always equal to, or greater than 75% of the occurrences, which shows the understanding of the variability of phonetic realization during language development.

The first element of the phonological system is acquired before the age of two. Plosives and nasals stabilize first and show less heterogeneity in acquisition. On the other hand, the fricative and liquid consonants are later and heterogeneous about the age of stability, in which those acquired later are stabilized at around five years of age or more. A similar feature in all studies is the observational design due to the character of the phenomenon observed. The wide variability among children is evidenced in longitudinal studies when analyzing the findings of different cross-sectional surveys.

Figure 2 summarizes the results and provides an overview of typical phonological development, contributing to the understanding of the acquisition of normality patterns for each consonant and syllabic structure in BP, which can serve as a guide for the clinical practice of professionals working with children.

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